BULLETIN OF THE

TAYLOR SOCIETY

A SOCIETY TO PROMOTE THE SCIENCE AND THE
ART OF ADMINISTRATION AND OF MANAGEMENT

Containing

THE THREE-SHIFT SYSTEM IN THE STEEL INDUSTRY

By Horace B. Drury

A STUDY IN THE ENGINEERING OF MEN

"The art of management. . . . No concise definition can fully describe an art, but the relations between employers and men form without question the most important part of this art." Frederick W. Taylor in *Shop Management*, p. 21.

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5. To inspire in labor, manager and employer a constant adherence to the highest ethical conception of their individual and collective social responsibility.

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COMMENT

IN this issue appears Mr. Drury's "The Three-Shift System in the Steel Industry," and the discussion following its presentation at the December annual meeting. The reports of the various committees appointed to study the application of scientific management to selling were published in Vol. V, No. 6, which was distributed at the meeting. Other papers presented at the meeting—the important papers and discussion on "Standardization of Product," and the stimulating address of Professor Friday on "Risk—A Retarding Factor in Production"—will appear in succeeding issues of the BULLETIN. Mr. Drury's paper is given precedence for the reason that it is a subject of great general interest and its early publication has been requested by many persons who have seen excerpts from and comments on it in the technical magazines.

IT is the report of a seeker after the facts, and it was fitting that it should first be presented for the critical consideration of the engineering profession. The trustees of the Cabot Foundation, by which the funds for the investigation were provided, appreciated the requirements of an engineering investigation, and made it possible for the investigator to have absolute freedom in his work and in the preparation of the report, and that the first report be made to the engineers. Mr. Drury brought to bear on the investigation a thorough training in economics and a grasp of scientific management—he is the author of a book on scientific management—and throughout his investigation he had the counsel of Mr. Morris L. Cooke, a mechanical engineer of experience in the development of scientific management in industrial plants and a student of public affairs. The author does not present the report as something final and conclusive, but the internal evidence of competence and impartiality will convince the reader that Mr. Drury has helped to take a big step forward in the consideration of an administrative and managerial problem of the greatest public importance.

THE report of the address in the *Iron Age* (Dec. 1920) is a model of competent reporting and the editorial comment in the same issue an example of reasonable appraisal. It says the author "has aimed to state fairly the position of manufacturers who continue to work on the two-shift plan. . . . After reading his conclusions . . . an onlooker might even be moved to wonder on which side the propaganda was working, concerning which a charge was made at the meeting which Mr. Drury addressed! . . . Operating men in the industry will not hesitate to say that, with all the allowances he makes for the difficulties that must be overcome in putting steel plants on a three-shift basis, Mr. Drury's report still takes too favorable a view of the results from the standpoint of cost to the company and of amount and quality of product. From the standpoint of working morale, of citizenship and of what is demanded by present-day standards in industry, the question of the continuance of the long day in the steel industry is getting more open-minded and reasoned consideration from manufacturers than it has ever had before. At no time have the conditions within and without the industry been more opportune for trying out the three-shift system and developing its best possibilities."

THE THREE-SHIFT SYSTEM IN THE STEEL INDUSTRY[1]

BY

HORACE B. DRURY[2]

ABSTRACT

At this time when many mills are laying off large numbers of men the question is being raised as to why any job need be 12 hours long. England has given up the 12-hour day in her steel industry, and so has France, Germany, Sweden, Italy, Belgium, Spain. There is no other large American industry which, like a steel plant, works the majority of its men 12 hours a day.

The writer has recently visited practically all of the some 20 American steel plants which are now running on three shifts. He has found that the men have been willing to make substantial concessions in daily wages in order to get the shorter hours. A 25 per cent increase in hourly rates is ample to compensate the men for a 4-hours' loss of pay. To give all the men now on 12-hour work a 25 per cent increase in wages and cut down their day from 12 to 8 hours, would cost a maufacturer of pig iron at the most about 21 cents a ton. Pig iron sells for $40. If all the departments in a steel plant were to be changed from two to three shifts, the increase in total cost for the finished rail, bar, or plate could not, on the average, be more than about 3 per cent.

But the increase in cost need not be nearly so great as these figures. By taking care, some manufacturers going on 8 hours have been able to reduce their force of men 10 per cent—some more. Others have found that the quality of their open-hearth steel has improved and that the expense for fuel and wear and tear on furnaces has been substantially reduced. Others have found that their rolling-mill output has gone up well toward 20 per cent, or even more.

The steel industry is not one in which output can easily be increased, and during the initial stages of three-shift operation most companies have had to stand some increase in labor cost but, taking it all in all, the manufacturers now operating on the shorter day are practically a unit in saying that it means more satisfactory operations, and is better business. Many detailed problems have had to be worked out; but certainly the experience of these 20 plants has shown that there is no outstanding obstacle to putting the steel industry on a three-shift day.

Today conditions are more favorable for introducing the three-shift system than they were at the time when most of the plants now employing it made the change. With labor as abundant as at present, the expense of wage adjustments would unquestionably be less, and the increase in efficiency substantially greater, than was true in the case of the companies whose experience is discussed in this report.

If the present favorable opportunity is not seized, it is apt to mean greater expense when the steel industry does decide to go to three shifts, as it is almost certain to do before the lapse of very many years.

In order to appreciate properly the problem involved in putting the steel industry of the United States on a three-shift basis it is first necessary that we have some knowledge of the steel industry itself and in particular of the extent and character of the existing two-shift operation.

It should not be necessary to speak before an audience of engineers of the importance to the country of the steel industry or of the manner in which practically all the other manufacturing industries rest upon it. This is the age of steel. Nearly all machinery and a very large part of the country's physical equipment along all lines is in this day constructed out of iron or steel. Not only is the steel industry in this special sense the foundation for all our productive activity, but it is in itself one of the country's greatest industries. Particularly, in the largeness of its physical equipment, steel stands out as a sort of super-industry; and likewise of overshadowing interest is the investment factor. Yet the industry is also a large one from the standpoint of employees, who must number altogether somewhere around five or six hundred thousand.[1]

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[1] An address delivered at a joint meeting of the Taylor Society, the Metropolitan and Management Sections of the American Society of Mechanical Engineers and the New York Section of the American Institute of Electrical Engineers, New York, Dec. 3, 1920.

[2] Recently with the Industrial Relations Division of the United States Shipping Board; formerly of the Economics Department, Ohio State University; Author of *Scientific Management* (Longmans).

I. EXTENT OF THE TWELVE-HOUR DAY[2]

The actual percentage of steel industry employees who under the two-shift system have been employed 12 hours a day has been variously estimated at from 26½ to 52 per cent. The truth of the matter would seem to be that, so far as concerns those continuous operation processes which make up the heart of the steel industry, such as the blast furnace, the open-hearth furnace, and most types of rolling mills, together with the various auxiliary departments necessary to keep these processes going, and make a complete plant, the bulk of the employees work 12 hours. The proportion of 12-hour jobs in these places is not a full 100 per cent; for the reason that in many of the departments there is a certain amount of work, usually of a common labor or mechanical type, which can be concentrated in the daylight hours and is commonly performed on a 10-hour basis. But all the shift men, all the men whose presence is essential to the carrying on of the processes, from the chemist and bosses down to the lowest helper—the technical graduate, the American-born roller, and the unskilled foreigner—all these, with very few exceptions work 12 hours. Most likely the percentage of 12-hour workers for the whole plant—which we are assuming is entirely, or almost entirely, devoted to the more fundamental steel processes—will be considerably over 50 per cent,—in some cases two-thirds.

But while fully one-half of the men in these plants or departments of plants which constitute the seat of the steel industry work 12 hours, the percentage of 12-hour men taking the American steel industry as a whole would be considerably less than 50 per cent, for the reason that all around these blast furnaces, steel works, and rolling mills there is a fringe of work which is classified as a part of the steel industry but is not continuous process work, or for some other reason does not run on two shifts. In the case of the United States Steel Corporation, for instance, some 70,000 of the 260,000 men whom the company normally employs are not in manufacturing plants at all but are employed in coal mines, ore mines, or on railroads, ships, etc. Most of these men would not, in all probability, work 12 hours. Likewise within steel manufacturing plants themselves, there are here and there departments which work on the more refined processes which follow the basic ones mentioned above, such as foundry departments, forge shops, machine shops, and fabricating departments of various sorts, which often work shorter hours. In a sense we do not include this type of work in our minds when we speak of the steel industry, yet in all the statistics of the industry they would be so classified, and they help materially to reduce the percentage of 12-hour men. Finally there are a few branches of the iron and steel industry proper which have for many years been on three shifts. This is true of puddling furnaces[3] for the making of wrought iron—not at present a very important branch of the industry—and of sheet and tin mills, hoop mills,[4] and perhaps some other special types of work where there is an excessive amount of manual labor. Sometimes also a plant will have its Bessemer converters or its coke works on a shorter day. Sometimes rolling mills are not run as a continuous process operation.

But we are now enumerating the exceptional cases. All in all there are probably enough men engaged in the raw materials end, or in the finished product end, of the steel industry in positions where the work is less than 12 hours to bring down the percentage of 12-

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[1] The Steel Corporation, which in normal times employs about 260,000 men, produces approximately 40 per cent of the country's steel products (in 1918, 40 per cent of the pig iron, 44 per cent of the ingots, and 42 per cent of the rolled products). A first approximation to the number of men in the steel industry would therefore give about 650,000. This would not include steel foundries or many other lines of industry dealing with steel products. I have, however, hesitated to put the figure as high as 650,000 because the Steel Corporation, to a greater extent than the "independents," has employees in transportation, coal mining, and other work removed from steel plants. An enumeration of the men actually in steel plants, as they would be counted in the census, would doubtless give a figure well below 500,000. Probably 600,000 is a fair approximation for the number of men in the industry, as commercially organized in normal times.

[2] The 12-hour day as used in this paper means a day which averages 12 hours. Sometimes men work 11 hours one week and 13 on the night shift the next; or even 10 or 10½ hours one week and 14 or 13½ the next. As indicated later in the text the shorter day-shift is often preferred by the men.

[3] We are not speaking here so much of puddling mills proper, which still work two shifts as a general rule; but rather of bushelling, which, differing from puddling in the narrower sense in that it uses scrap instead of pig iron, has largely displaced the former process, and appropriated the common name. Some puddling furnaces (in the old sense of the word) and most bushelling furnaces are on three shifts.

[4] According to several persons interested in the steel industry, including the officers of one hoop mill visited. It is possible, however, that a wider survey of hoop mills might lead to a different conclusion.

hour men for the entire industry to one-third, and if one makes the boundaries of the industry wide enough perhaps to nearer one-fourth. No exercise in percentages can, however, alter the fact that in the great nucleus of the steel industry, where most of the men are employed, in the great plants where iron ore is made over into pig iron, pig iron into steel, and steel into various rolled shapes (excepting sheet), the body of the workmen are on duty 12 hours a day. Whether the 12-hour workers be considered as 50 per cent of 300,000, or as 25 per cent of 600,000, makes not the slightest difference. Working in plants where for the most part they have constituted a majority of the workers, these men, who must number altogether about 150,000, have until recently had no alternative other than the 12-hour day, unless they would change their occupation. For them and for their families, numbering perhaps a half or three-quarters of a million of people, the 12-hour day has become a fixed industrial habit, firmly intrenched in the traditions of the industry and in human lives and habits.

It should be added that in the case of blast furnaces there is not only the 12-hour day but the 7-day week, and with the 7-day week there is associated one very objectionable feature, the 18-hour or 24-hour turn which comes to one-half the men whenever the day shift and the night shift exchange places. The 7-day week is also a common feature of open-hearth work, though some open-hearth furnaces operate only six and a half days a week, and some only six. Rolling mills rarely operate longer than six days a week.[1]

II. REASONS FOR THE TWELVE-HOUR DAY

When these facts regarding the large volume of 12-hour work in the steel industry first became a matter of general knowledge and discussion some ten years ago and then again last year, a great many people were surprised to learn that so large a group of men could have gone on all these years practically untouched by the movement toward shorter hours. As a matter of fact the development and continuance of the 12-hour day in the steel industry was the rather natural outcome of special conditions, an understanding of which must precede any intelligent approach to the problem of putting the steel industry on three shifts.

There is of course no difficulty in explaining how the 12-hour day started. It was once the ordinary practice in all sorts of industries in England and in the United States.[2] Nor is there any difficulty in explaining why the steel industry, in common with all other continuous process industries[3] should have adhered to a 12-hour day longer than those industries where all the work is done by one set of men. In "single-shift" industries, if we may use that term, the working day can be fixed at any convenient length. But in industries that run 24 hours, the men working shifts must work either 12 hours, 8 hours, or some other even fraction of 24. Now the jump from 12 hours to 8 is a big one and it was quite natural that for a long time after many industries had reduced their hours from 12 to 11 or 10, the steel industry should continue to operate for 12; and the impossibility of making any very gradual reduction of hours for shift workers is doubtless one of the reasons why the steel industry has until this day hesitated to make any change.[4]

But although the awkwardness of the jump from 12 to 8 hours for many years kept most continuous process industries on a 12-hour schedule, for a number of years past various such industries have been very rapidly switching over from two to three shifts. There must therefore be some special reason why this did not tend to take place in the steel industry; and to a review of such reasons we shall now turn.

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[1] The 7-day week has, however, been outlawed so far as concerns plants of the U. S. Steel Corporation. Blast furnaces must, of course, operate seven days; but the Corporation has ruled that the individual men must take off one day in seven. By March, 1912, according to a report issued in that year by what was then the Bureau of Labor (*Report on conditions of employment in the iron and steel industry,* Sen. Doc. No. 110, 62 Congress, 1st Session, Vol. iii), the Steel Corporation had (excepting for a very few employees) eliminated 7-day labor in all but one of the Corporation's plants. During the war, the rule against 7-day labor was admittedly not enforced. But Mr. Charles L. Close, Manager of the Corporation's Bureau of Safety, Sanitation and Welfare, now states that the prohibition of the 7-day week, and the abolition of the long turn, is again being rigidly insisted on. He believes that it exists today in only very exceptional cases.

Among the "independents," the 7-day week is, however, still a very widespread practice. As to whether the 7-day week is an evil when the daily turn is reduced from 12 to 8 hours, is a question which will not be taken up in this paper. Where the introduction of the three-shift system ends the long turn, and the day off would not (except rarely) come on Sunday, there are arguments for as well as against 7-day work; it being possible, in fact, so to arrange the system as to give the workers a substantial percentage of their Sundays off.

[2] Cheyney (*Industrial and Social History of England,* p. 249) declares that "the actual working hours in the factories in the early part of the (nineteenth) century were from twelve and a half to fourteen." Of this country, Bogart (*Economic History of the United States,* p. 254) states that one of the aims of the labor movement of the thirties was to reduce the hours of labor to a day of from "six to six."

[3] Twenty-four-hour operation is absolutely essential for the blast furnace; it would be very wasteful to operate an open-hearth furnace in any other way (though the open-hearth furnace may be eased up on Sunday); and it is the custom—not quite always followed—to operate rolling mills continuously (closing down on Sunday).

[4] It is claimed that three-shift work was more common in the steel industry 25 years ago than in recent years, the introduction of less laborious methods of work having made possible a lengthening of the day.

In the first place it is of the utmost importance to understand that most of the work in the steel industry is quite intermittent in character. In most plants one is told that a man does not work more than about 6 or 7 hours on a 12-hour turn, and to one passing through the works this is just about the general impression conveyed. At one of the blast-furnace plants visited a measurement of the working time by efficiency engineers showed that on the average the men were employed less than 50 per cent of the time. Much the same thing is true of open-hearth work, and in the case of rolling mills there are apt to be long waiting periods, or, especially in certain kinds of work, the men are apt to work in spells. So that in all these main branches of the industry, the work is in almost all cases highly intermittent, and while the men are in the plant 12 hours, it is doubtful whether on ordinary days they are actually occupied as long a time as are the men in most 10-hour, and perhaps in some 8-hour plants. Eight hours of actual work would certainly be a liberal estimate for most steel industry 12-hour jobs.

Nor during recent years has the work which the men perform when they are working usually been of a very heavy character. Once this was so. A good deal of heavy labor still remained at the time when Mr. Taylor did his celebrated work at Bethlehem. But nowadays one does not find the pig-iron handler, or anybody shoveling ore. The pig-casting machine, the open-hearth charging machine, not to mention the blast furnace skip hoist, the electric crane, and the mechanically operated rolling mills, have revolutionized the industry. There is a good deal of cleaning-up work that is not pleasant while it goes on, and odd jobs of varying degrees of difficulty, hard and hot shoveling at times around the open-hearth furnace, and severe labor on the hand-operated rolling mills. But for the most part the steel worker of today is simply moving levers, or watching and waiting while the heat and machinery do the work. There is still a large element of hazard, and in places a good deal of exposure to heat; but conditions for the most part are far from being of a shocking sort—especially when one has become used to the spectacular magnitude of everything and realizes that the machinery does not rest on the men.

But, it may be asked, if steel industry work is so slack why do not the employers cut down the force, give everyone steady work and let the men go home at the end of 8 hours, or 10? I should not be surprised if the problem should eventually work itself out somewhat along those lines. But there is this very serious difficulty, that while the men may not be actually working all the time a certain force of men is needed for emergencies. The work in a steel plant is irregular in its irregularity. Some days everything goes perfectly and the work is slight. Other days there is a lot of trouble and for hours all hands will be needed. Furthermore a part of the idle time, especially in the rolling mills, is due to waiting for ingots, or to time lost while changes are made in the rolls. The complete elimination of mishaps and badly balanced conditions, though highly desirable, would be unusually hard of attainment in an industry where the things to be correlated are as unwieldy as in the steel industry. So a condition has become general in which the managers choose to have on hand a fairly adequate number of men, working at an intensity which permits them to stay around for 12 hours.

This is the management's side. So far as the men are concerned, they have for the most part acquiesced in the 12-hour day because physically the manner of work was such that they could stand it, and financially they were receiving in exchange for spending their spare time in the works an additional hour's pay for every extra hour worked. In view of the unusually large number of hours worked per week it is possible that hourly wage rates may not always have been fixed as high in the steel industry as they would otherwise have been; so that it may be doubted whether the weekly earnings have always been increased by as much as the number of extra hours.[1] Even had the steel workers felt that this was so, it is doubtful, however, as to whether it would have changed very much the attitude of the majority of the workers toward the long day; for, as a matter of fact—and we come now to the main reason for the continuance in the steel industry of the 12-hour day—the steel industry has for many years recruited its workers from a class of men to whom this combination of long sluggish hours, with rather high weekly earnings, has had a peculiar charm; and that is the class of newly arrived foreign-born workers.

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[1] Considering the increases in the wage rates of steel workers during and since the war it is doubtful, however, as to whether hourly rates in the steel industry are now low as compared with those in other industries. The nominal rate is perhaps low; but considering the fact that the men are paid time-and-a-half for all work over 8 hours (one-third of their day) the average hourly rate is raised to a respectable figure. Thus of the 29 industries listed in Table I (See p. 10), the average earnings per hour worked were higher in the steel industry than in any other. That was at the beginning of 1919. Later there were substantial wage increases in many industries, while wages in the steel industry remained on a level; also the figures for the steel industry must have included some skilled workers who earn extremely high wages. Nevertheless the lowest pay in the industry is not bad, especially when the total earnings for the long hours are figured in. The lowest rate for unskilled labor which I came across this fall (as a result of more or less casual inquiries) was 46 cents an hour straight time and 69 cents an hour overtime. While it is reported that lower

The typical steel worker,[1] whose psychology has acquiesced in and in many ways encouraged the continuance of the 12-hour day in the steel industry, is an unmarried man without a real home in this country whose one idea is to earn just as much money as possible and then go back to Europe. Or he may be married, but working to bring over his family. Men of this special type would sometimes be willing to work four extra hours for almost nothing. Outside is alien America; inside is the one environment to which they have become in a measure accustomed. Outside are the squalid streets and often wretched dwellings, and nothing special to do except to dissipate the money that one is trying to save; inside are one's fellow workmen and companions.

In some of the plants lounging rooms are provided (usually a shanty, but a place where the men can congregate); and in some there are classes in English during the men's leisure time. One smokes, talks, reads if he is able to or cares to. On the night shift everybody sleeps a part of the time, from the boss down—though it is not officially supposed to be this way—and there is a good deal of sleeping in the daytime. Sometimes the day shift is only 11 hours long, the men feeling that if they are going to work at 6 P. M. anyway, they might as well go at 5, thus making a night shift of 13 hours but a day shift of only 11.

In fact there has grown up among these foreigners, and among the Americans as well, a special mode of existence in which the shop rather than the home, or other outside institution, has become to a large extent the center of living. Just as sailors have learned to spend their lives at sea, miners to spend much of theirs under ground, and traveling salesmen and engineers to spend much of theirs away from home, so the steel worker spends his life in the shop. And while to those of us in other callings this might seem like the last thing that we should want to do, to the steel worker himself this special mode of life is sometimes not without its attractions; and—especially after he graduates into an office—it may become a sort of glorious thing.

This, of course, is the idealistic side of the picture. Not all of the steel workers are of one mind as to the desirability of this manner of life. Nor is it all so rosy or satisfactory. But this picture is a true one to a very considerable extent, and keeping in mind always this great flood of foreigners whom love of money (or some other ambitious motive) has torn away from their old cultural attachments in Europe and brought across the sea, it helps to explain the often repeated statements of steel men that they would be

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rates than these were paid in some localities (mainly in eastern Pennsylvania), well on towards half of the steel workers in the country appear to have been paid at precisely the 46 and 69 cent rates. This means that the lowest-paid 12-hour man (except in plants which have been below standard) has received $6.44 a day, $193.20 for a 30-day month, and $2,318.40 for a 360-day year. This may not be more than a man ought to earn, but it is certainly more than unskilled labor is paid in most industries. It seems evident, therefore, that the steel worker is actually paid high wages for his long hours.

Since this paper was presented (December 3) slack work and falling prices have brought wage reductions in various sections of the steel industry, so that rates as low as 30 cents an hour are reported in at least one instance. (More commonly, however, the new rate is 35 cents or 40 cents.) The time-and-a-half rate for overtime has also been abandoned in places. Up to the present moment no general reduction has, however, been reported for the industry's largest employer.

[1] In presenting the partially compensating features of the 12-hour day in this paragraph and those which immediately follow, I do not wish to be understood as representing that the steel worker would actually choose the shop in preference to being at entire liberty outside. Here and there an individual whose hours have been cut down has been known to spend his extra time about the shop; but I should suspect that the number of such individuals has always been extremely small. There would, however, appear to have been a substantial number of men who put relatively small stress on hours and very great stress on pay. Considerable groups of these would balk at a reduction in hours which meant even a few cents reduction in earnings, and very many, indeed, would object to a reduction in hours which deprived them pro rata of their earnings. The eagerness for the earnings which come with long hours has been strongest among the lower paid, partly because this group contains a larger portion of immigrants and partly because the lower paid group has more difficulty in attaining a desired standard of living. The situation has, however, been complicated by the fact that the turn positions which have the long hours are often higher and more desirable than the 10-hour positions and also by the payment of overtime rates for all work over 8 hours. In the latter part of this paper evidence will be referred to which goes to show that with the growing Americanization of the foreigner, the rise in earnings during the war, and the greater thought being given nowadays to the matter of hours, sentiment among all classes has been turning against a 12-hour work day. I do not mean to contradict the findings of careful students of labor conditions who from studies made among the workers found that years ago many steel workers objected strongly to the 12-hour day; for naturally there would be many such. But circumstances, force of habit, and the contrary wishes of other workers seem to have prevented any movement toward shorter hours from gaining substantial headway.

glad to abolish the 12-hour day but the men are against it.[1]

It is possible, though not certain, that the steel industry would have made greater progress towards getting away from the 12-hour day in spite of the situation just described, had it not been for special circumstances in which the industry has found itself for the last few years, the chief of which has been a shortage of labor. During the war, and then again during a period of many months beginning not so very long after the armistice, it was so difficult to get men as to constitute an important factor in keeping steel manufacturers who might otherwise have gone on three shifts from doing so. To some, the shortage of labor may seem altogether an excuse. We know that when a great demand comes on industry, for instance the war itself, it is somehow met. The labor is found somewhere. Ship building and the steel industry itself were greatly expanded during the war, in spite of a scarcity of labor. So it might be thought that had the law or some equally potent force required it, the three-shift system could have been introduced. Probably so. But that the sudden introduction of the three-shift system would have put the steel industry to a considerable hardship is evidenced by the fact that the shortage of labor even without going on three shifts was such as to make necessary unusual measures. Thus in the last year or two there has been a constant stream of Negro and in some places Mexican labor moving into the steel industry. It may be that in the end such a movement will not be a bad thing, but everyone acquainted with the movement of Negro labor to the north during the last year or two knows that for the time being it has raised a serious social and a serious industrial problem. In view of this situation as well as the effect which a more pronounced shortage of labor would have on wage rates, it is not surprising that the bigger steel manufacturers should have hung back from going to the three-shift system under the conditions of the last few years. Probably the shorter day would in the end widen the group of labor to which the steel industry could appeal and in time be its own solution to the problem of labor shortage; but this would not prevent a difficult situation from arising at the outset. Besides the shortage of labor, the shortage of houses in steel towns has presented another very serious obstacle.

It seems probable that the very largeness of the steel companies may have been another impediment in the way of bringing about any innovation as regards hours. Great bodies move slowly, whereas in an industry allowing more scope for individuality, someone is more likely to venture on an experiment.

A more important factor than the size of the companies, however, would seem to be the fact that the steel industry, more largely, perhaps, than any other industry in the country, has been free from the influence of any sort of labor organization. Individually men in all walks of life are tempted to give up their leisure in order to earn a little more money and raise themselves and their families a little higher in the social scale. But when men are organized in unions (or even shop committees) they come to feel that if they all agree to work a standard day of reasonable length all will be as well off relative to one another as before, and the larger measure of leisure will more than counterbalance the reduction in weekly earnings, if such there be. The unions are not always able to keep their individual members from striving for overtime and greater earnings at the expense of hours, but the union movement has unquestionably exercised a good deal of pressure towards the shorter day.

Now the steel industry has for the most part escaped the unions. There is only one bona fide union in the steel industry, the Amalgamated Association of Iron, Steel and Tin Workers, and except in a very few plants this union had up to the time of the strike confined itself almost altogether to puddling furnaces and sheet mills. A few isolated blast furnaces were organized some years ago and in 1911 put under the jurisdiction of the International Union of Mine, Mill, and Smelter Workers with headquarters in Denver, but the number of organized furnaces remained exceedingly small. Last year a large proportion of the steel workers were for the first time in many years suddenly brought together into a union movement; but after a serious strike, the movement almost completely broke up.

That the long acquiescence of the steel workers in the 12-hour day bears some relationship to this lack of unionism would seem to be indicated by the fact that until recently almost all of the tendencies towards shorter hours in the steel industry have been in those very few branches, or in those almost infinitesimal areas, where labor organization did have its precarious foothold.[1]

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[1] But see again Note 1, p. 6.

III. REASONS IN FAVOR OF GOING FROM TWO SHIFTS TO THREE

It is the primary purpose of this paper to recount the actual experience which steel manufacturers have had in introducing the three-shift system, rather than to make the discussion a mere debate regarding the abstract arguments in favor of three as against two shifts. But having, in the interest of a better understanding of the problem, which the three-shift manufacturers have had to face, recounted with some care the reasons why the old two-shift system became so deeply imbedded in the traditions of the industry, it is only fair that some mention be made of those yet weightier reasons why in fairly recent times a great many steel men have come to feel that the days of the two-shift system are definitely numbered.

First I wish to remove the impression which may have been created that the matter of health is not involved at all. While the general opinion of well informed steel men, even those who are much in favor of three shifts, is that the 12-hour day is not hard on the men physically, such a statement is probably only approximately correct. It is hard to believe that 12 hours in a shop is as good for a man physically as 8 hours in the shop and the balance outside. It seems possible that if we had health records as accurate as those which we shall later examine for the quality of open-hearth steel, we should find that 8 hours would keep a man in better health and increase his longevity in comparison with what would be the case under 12 hours.

But whatever may be the truth with regard to the 12-hour day as it is ordinarily met with in the steel industry, all well-informed persons will agree that there are times and places when the long day does mean 12 hours of gruelling work. When something goes wrong on the inside of the blast furnace, when the open-hearth furnace needs constant attention during a long period of hours, then there can be no doubt but that the 12-hour day is a strain. Also the 12-hour day when joined with the 7-day week makes an especially vicious combination. It means that once every two weeks or so a man is on continuous duty for 18 or 24 hours, while only once during this two-weeks period does he get off for any longer period than 12 hours. The system is without a factor of safety, so that when emergencies compel a man to work overtime, or stand the turn of some one else, strain at once sets in. The long hours also have the indirect effect of stimulating a man to excess when once in a while he does break over the traces and take a day or several days off.

So it would probably be assuming a good deal to say that the 12-hour day is in no respects a strain on the health of steel workers. Yet the principal argument against the two-shift system is not the physical argument. If men had bodies only, if they had no other purpose in life than to make money for themselves and their employer, it would be doubtful as to just how strong an argument could be made against the 12-hour day. The true nature of the two-shift problem becomes apparent only when we begin to think of a steel worker as a man, stirred by the same impulses and having much the same out-of-shop interests and obligations as have other working people and other citizens. It is not so much because of what goes on inside the shop as because of what a man misses outside that the steel workers in these later days are beginning to change their minds about the advantage of the 12-hour day; while many other persons, both outside and inside the steel industry, are becoming concerned over the same problem.

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[1] Puddling and sheet mills, the two partially organized departments, are the only branches of the steel industry where the three-shift system is at all general. True, the work in both these departments is so arduous that it has been demonstrated that the shorter day is more efficient; but the shorter day would probably also be more efficient—though not so much so—on the cold rolls (of sheet mills); but the cold-rolls department, which is not so well organized as the hot-rolls department, has not so generally had the shorter day. (It means that the day about the hot mills was first reduced to two shifts of less than 12 hours each, and that technical conditions favoring continuous production were a factor in favoring the introduction of three 8-hour shifts. The cold rolls are not operated strictly continuously, because of time required for grinding the surfaces of the rolls.)

One of the first of the more diversified steel plants to go on three shifts was the one steel plant which stands practically alone as being organized throughout. Of the blast furnaces now on three shifts a considerable number belong to that almost undiscoverable section of the blast-furnace industry which is organized. The introduction of the three-shift system into open-hearth and rolling-mill work has largely taken place in establishments which have already had the three-shift system in sheet mills; so that there was, in some cases, an indirect connection between union organization and the extension of the three-shift system. In some other cases it is possible to trace a more or less direct connection between the three-shift system and union influence; and, where there is no union, employers going to three shifts have in a number of cases had shop councils.

On the whole, however, the three-shift movement described in this paper has been an employers' movement, aided considerably by sentiment already developed in favor of a shorter day, but in the main pushed through by the management. It has, of course, been highly important that the men understand and cooperate in making so great a change.

What sort of a home life, one hears it asked on all sides, can a man have who, including the time lost in coming and going, is on the job practically 13 hours every day? Add to this an hour for meals and 8 hours for sleep, and barely 2 hours a day are left for the duties and pleasures of family and community life. For a few years the ambitious, newly arrived immigrant may seek such a life; and throughout life, the dull man, or the one-interest-in-life man, may run on contentedly on this schedule. But any indefinite continuation of such a system for a block of several hundred thousand persons would simply mean the accentuation and continuance in American life of those lines of class and culture which immigration has already made too dangerous and deep. Who wants to have in America a class of men who do not know what to do with themselves unless they are under the orders of some one else? Is this the way to raise the general level of literacy and personal capacity, and build up in America a civilization in which we may take pride? The argument against the 12-hour day based on the proportion of a man's time which it consumes is in short simply unanswerable both from the standpoint of individual freedom and development, and from the standpoint of national power and culture.

I believe that it is very largely this humanitarian and national welfare aspect of the 12-hour day which is most in the minds of that large body of steel men who express themselves nowadays as opposed to the two-shift system. There is, however, another objection to the 12-hour day which should appeal especially to the members of the Taylor Society, and to all those engineers who are interested in the more effective utilization of human labor; and that is the fact that, so long as the steel jobs are on a 12-hour basis, the way is practically closed against the building up in the industry of any substantially more efficient or responsible labor force. Just how much more efficient labor can be on 8 hours than 12 and how much this greater efficiency is really worth in the steel industry, will not be apparent for a good many years. The whole layout of the industry and the spirit which pervades its functioning has necessarily grown up to fit the 12-hour day. The attitude of the workman, in feeling that he must hang back from work about half the time, the attitude of the foreman who feels that to get anything done at all he must drive, the lax moral tone which must pervade an industry where sleeping is tolerated, all these cannot but be reflected adversely in the attitude of the men towards waste, towards care of tools and equipment, towards responsibility for quality in the product, towards absenteeism, and towards the development in industry of the scientific spirit. None of these ill-favored children of long hours can be made to disappear in one year or five years. But from the standpoint of those forward-looking individuals who would study the efficiency of processes and men in the steel industry, with the idea of building constantly a better organization, it would seem that the very first thing to do would be to get the men away from the 12-hour day. Who will deny but that in the long run a brighter future is bound to lie before an industry which has learned that work is work, and has decided that long dull hours, and half-asleep workmen will no longer do?

This, however, is looking beyond the present into the future. The decisive test as to whether the time is at hand when the steel industry should or must go on a shorter day should be furnished by an examination of hours in other industries more or less similar in nature. For if the entire country gets very far away from the 12-hour day, any man knows that there is small likelihood of one industry remaining perpetually on a different basis. The tendency towards standardization in the habits and ideas of people is too strong. For a generation or so rather strong differences may survive. But eventually people want to live and work like other people. The steel workers of today are more affected by what goes on in other industries than formerly. What, therefore, taking the country as a whole, is the drift today in matters of hours of labor?

Table I shows the hours worked in a number of the country's most important industries as compiled by the United States Bureau of Labor Statistics. This table, it will be observed, is not for the entire industry but is based on representative plants. It does not show the full extent of 12-hour work in the steel industry for the reason that the table shows not the hours of labor on any one day, but the average number of hours per day for each man during a pay-roll period. Thus if during a given two-weeks period, a 12-hour man worked only 6 days, or 72 hours altogether, his daily average would be 1/12 of 72 hours or 6 hours; and he would be classified not as a 12-hour, but as a 6-hour man. So the figure of 17 per cent is not to be taken as the proportion of 12-hour men in the industry. The figures are for the beginning of 1919 when work was so irregular in these steel plants, or labor turnover so high, that there were actually more men averaging less than 4 hours a day than there were over 12. Nevertheless, Table I does

TABLE I.—NUMBER AND PER CENT OF MEN AVERAGING 12 HOURS OR MORE PER DAY IN SPECIFIED INDUSTRIES[1]

Industry	States Included	Total Men	12-Hour Men	
			Number	Per Cent
Iron and steel	15	31588	5497	a17.4
Chemicals	25	28478	2367	8.3
Paper and pulp	14	6379	444	7.0
Glass	9	11738	791	6.7
Brick	11	1773	85	4.8
Coal:				
Anthracite	1	16216	617	3.8
Bituminous	18	40541	272	.7
Foundries	28	15340	364	2.4
Machine Shop:				
Machine tools	11	7817	40	.5
Other machinery	27	14931	298	2.0
Rubber	9	15134	272	1.8
Confectionery	19	4370	54	1.2
Automobiles	7	17812	98	.6
Boxes, paper	10	1805	10	.6
Cars	14	15606	25	.2
Cigars	10	5223	2	.04
Clothing, men's	9	9926	19	.2
Clothing, women's	7	3127	0	0
Electrical machinery	8	4369	6	.1
Furniture	13	10615	35	.3
Hosiery and Underwear	15	2607	10	.4
Leather	9	7920	59	.7
Logging	21	7330	42	.6
Lumber	22	18022	170	.9
Millwork	13	5154	13	.3
Overalls	19	358	1	.3
Pottery	4	2142	0	0
Silk	7	3755	27	.7
Typewriters	10	8870	58	.7

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[a] As explained in text this figure does not show full extent of 12-hour work. In most steel plants the proportion would probably be over 50 per cent.

[1] The figures upon which this table is based are taken from Table 5 of Bulletin No. 265 of the Bureau of Labor Statistics, *Industrial Survey in Selected Industries in the United States*, 1919. The arrangement has been altered to serve the purposes of this study, and the per cent figures added.

TABLE II. SOME ORGANIZED TRADES WHICH HAD BY 1919 GONE ON 8 HOURS[1]

Asbestos workers

Boiler makers and iron shipbuilders

Bridge and structural iron workers

Cigar makers

Cutting die and cutter makers

Firemen, International Brotherhood of Stationary

Glass workers

Hatters

Postal, and railroad postal clerks

Carpenters and joiners

Lathers

Painters, decorators and paper-hangers

Tile layers and helpers

Hod carriers

Roofers

Granite cutters

Stone cutters

Quarrymen

Miners, Western Federation of

Typographical Union

Printing pressmen's union

Photo engravers' union

Powder and high explosive workers of America, united

Paving cutters' union

Paper makers, international brotherhood of

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[1] *Report on the eight-hours day or forty-eight hours week,* prepared for Item I of the Agenda by the Organizing Committee of the International Labor Conference of the League of Nations, held in Washington, 1919, pp. 53, 54.

TABLE III. NUMBER OF MEN IN SEVERAL IMPORTANT INDUSTRIES WHO HAVE IN LAST FEW YEARS GONE ON 8 HOURS[1]

Industry	How brought about	No. men affected
Railroads	Basic 8-hour day by Adamson Act. Now being made actual 8-hour day in practice.	432,000
Ships	Three-watch system established by agreement for sailors (in 1919 on Atlantic, previously on Pacific); by law for officers and firemen.	125,000
Ship yards	Labor adjustment board	134,000
Anthracite coal mines	Agreements	147,000
Slaughtering and meat packing	Federal arbitration award	100,000
Garment trades	Collective agreements	178,000
Machine trades	Agreements	116,000
Government construction work	Agreement between Sec'y of War and Pres. Am. Fed. of Labor.	108,000
Lumber and saw mills, Pacific coast	Action of employers at Government's suggestion	50,000
Harness and saddlery industry	Executive order (applying to Government work)	Agreements signed by 100 manufacturers
Newsprint paper industry	War Labor Board	19 establishments

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[1] *Report on the eight-hours day or forty-eight hours week,* pp. 55, 57. The writer has added the statement regarding ships, and part of the statement regarding railroads. Longshoremen are also on an eight-hour day, but employment is very irregular, so that the men often work less or more than eight hours. The extent of the eight-hour day in government employment is not adequately represented above or in Chart II.

measure about as authoritatively as anything one could find the relative prevalence of the 12-hour day in most of the country's more important industries. It shows that the steel industry is the very last of all the industries in the United States in the matter of eliminating long hours. The chemical industry here ranks next to the steel industry, but as the table indicates, the chemical industry has in recent years made great strides towards changing from the two-shift to the three-shift system. The paper industry was once on two shifts, and still is in some localities; but most of the plants covered by this study evidently had gone to the shorter day. The glass industry, which was once on two shifts, is now for the most part on shorter hours. In coal mining there are some pumpmen and others who work twelve hours; but the proportion of such persons in the whole industry evidently is small.

As further illustration of the momentum of the movement towards shorter hours, Table II gives some of the organized trades which by 1919 had gone on eight hours; and Table III gives the number of men who in several important industries have in the last few years had their day reduced to as low as 8 hours.[1] Of these industries railroading was one which not many years ago operated on long hours; but first the basic 8-hour day was introduced and now the actual 8-hour day is rapidly coming in. Even on ships the three-watch system became universal for American ships in 1919, the only exceptions now being radio operators, and the sailors on the Great Lakes.[2]

In the face of what is no less than an overwhelming movement away from 12 hours, it would seem that no further proof should be needed of the desirability of the steel industry's giving up the two-shift system; but if doubt still exists, it should be dispelled by observing what has been taking place in the steel industry itself in all of the world's leading steel centers outside of the United States.

In Great Britain the movement towards three shifts was begun in blast furnaces as long ago as 23 years; and by ten years ago was so well under way as to be the rule in the steel and tin plate industry of Wales, and a common practice in the blast furnaces of the north of England[3]. The late war retarded the rounding out of the three-shift system in England; but in March, 1919, those furnaces and other branches of the steel industry which had not already done so went over to three shifts; and today persons returned from England state that the three-shift system is the accepted practice throughout the English steel industry and is working to the satisfaction of all concerned.[4]

In Belgium an agreement was entered into between the employers and workers by which beginning with January 1, 1920, the 8-hour day was to be observed at blast furnaces.[5] In France, a law of April 23, 1919, established the principle of the 8-hour day, leaving to public administrative regulations the fixing of the conditions under which the principle should be applied. Without waiting for such regulations to be issued, however, the French employers and employees in the metal industry, and a number of other industries, made their own agreement, to go into effect on June 1, 1919.[6] In Germany the law also limits the working day to 8 hours, subject to such exceptions and conditions as may be defined by Decree or Administrative Order.[7] In Sweden the 48-hour week is generally applied in iron works.[8] In Spain the 8-hour day was first adopted by agreement for iron and metal workers in a long list of cities, and then, effective October 1, 1919, the 8-hour day was established by Royal Decree as the general rule for all industries.[1] In Italy there is an agreement limiting hours in the iron and steel industry to 8 hours a day.[2] Unless it be in the Orient there is, therefore, no important seat of the steel industry present or prospective excepting the United States where the two-shift system has not already passed away. It is to be hoped that in this matter we do not try to hide behind the Chinese or Hindoos.[3]

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[1] While the fact that many industries, especially in foreign countries, have gone to the 8-hour day is the strongest possible evidence that the 12-hour day is out of date, it is important to bear in mind that the three-shift system is not in itself equivalent to the 8-hour day. Because of the necessity of dividing 24 by 2 or 3 (or 4), shift workers do in fact usually go to 8 hours. But there is nothing to prevent the men who have been working 10 hours from continuing to work 10 hours, or indeed to prevent a part of what has been shift work from being made over into 10-hour work. While some large plants have gone on an 8-hour day throughout, the more common practice has been to retain considerable 10-hour work. In this paper, therefore, we shall not deal with the 8-hour question as such. But we shall assume that the introduction of the three-shift system means that shift workers will go to 8 hours, while men not on shifts will, as in the past, work a day of whatever length the general conditions and customs of industry, and the wishes of the men and management, makes desirable. It is the avoidance of the 12-hour day that is the important consideration.

[2] Lake shipping is for the most part a branch of, and controlled by, the steel industry.

[3] See *Report of Special Commission on Hours of Labor in Continuous Industry,* presented to the Seventh Delegates Meeting of the International Association for Labor Legislation, Zurich, 1912.

[4] As reported by Mr. Whiting Williams who spent the summer of 1920 studying the English steel industry. See Mr. William's discussion on a later page.

[5] *Report on the eight-hours day or forty-eight-hours week,* prepared for the International Labor Conference of the League of Nations, held at Washington, 1919, pp. 66, 67, 90.

[6] *Ibid.,* pp. 69-74, 99.

[7] *Ibid.,* pp. 5, 6.

[8] *Ibid.,* p. 85.

Granting then that the elimination of the 12-hour day is essential to the higher development of American steel workers, and that the country and world at large have come to think of 12 hours as too long a day's work, it is obvious that whether or not the shorter day can be made of direct profit to the industry, it would be courting trouble for the industry to persist indefinitely in maintaining a system which the public generally condemns. The attitude of the public, even that part which is friendly to the steel industry, is well illustrated by the language in which the Senate Committee, which investigated and denounced the steel strike, used in speaking of the 12-hour day:[4]

> "It is true that some of the workers testified that they wanted to work longer in order to get increased compensation, but most of them seemed anxious for an eight-hour day with a living wage. The policy of working men 10 and 12 hours per day in the steel mills is, it seems to the committee, an unwise and un-American policy. There are many hundreds of thousands of employees in the steel mills, a considerable portion who cannot read, speak, or write the English language. It is claimed by the Steel Co. that a very large proportion of those who are out on the strike are foreigners, which is defined in the evidence to be non-English-speaking people. The testimony sustains this contention.
>
> "The 8-hour day is involved in the solution of this question. These non-English-speaking aliens must be Americanized and must learn our language, so the question of a reasonable working day is involved in the question of Americanization. Men cannot work 10 hours and 12 hours per day and attend classes at night school. . . . An 8-hour day with a living wage that will enable men to support their families and bring up their children according to the standards of American life ought to be a cardinal part of our industrial policy and the sooner the principle is recognized the better it will be for the entire country."

Now a Senate and Congress that feels that way about the 12-hour day would be as likely as not to pass a law prohibiting it altogether if it was evident that the industry itself would make no move in that direction. Things as bad as that have happened, as in the case of the Adamson Act. And if there were no law passed and the 12-hour day still continued, then it seems almost certain that the industry would simply be adding so much fuel under the boilers of some future steel strike, or series of strikes. In spite of the apparent willingness and desire of many men to earn 12 hours' pay, there can be little question but that it was the 12-hour day which more than anything else supplied the popular motive power back of the 1919 strike. And the strike was a serious one for the steel industry. There might have been a strike had there been no 12-hour day; and, conversely, the ending of the 12-hour day will not completely solve all the steel industry's labor problems. But to continue the 12-hour system in the face of the general drift towards shorter hours already referred to would simply be to plant dynamite. Then—whether or not there is a law passed, or a strike—the fact is that with the passing of the old type of immigrant and the general movement towards shorter hours which is even stronger in Europe than in the United States, the steel industry will not long be able to get an adequate labor supply unless it introduces a working day which will be more attractive to working people. Even if the men could be obtained the sentiment is becoming such that employees would be smarting under a sense of oppression formerly not very much felt; so that the efficiency of the 12-hour day, probably never very high, would seriously suffer. In a word, the steel industry seems to be face to face with the inevitable. The change is coming; and the chief question is not whether it will come, but in what manner is it to be brought about? How will it work? How much will it cost? Is it possible to bring the change about so that instead of its being a financial loss, it will be a gain? It was in order to obtain light on the answers to these questions that during the last three months I have visited practically all of some 20 steel plants, which, seeing how things were going, have already changed from two to three shifts. And it is the results of the experiences of these companies which I propose first to illustrate, and then to summarize.

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[1] *Ibid.*, pp. 82, 103.

[2] *Ibid.*, p. 81.

[3] I have no information regarding China and India, so that this allusion is only to the possibility of standards developing there that are akin to those now prevailing in the United States. As regards Japan, I am indebted to Mr. Hiroshi Iwata of the Mitsubishi Steel Co. for the information that the three-shift, 8-hour day system has been adopted in his company's blast furnaces, open-hearth furnaces, rolling mills, coal mines, etc. He says that the tendency in Japan is all in the direction of the speedy adoption of shorter hours. He gives the impression that the three-shift system is the prevailing tendency in the Japanese steel industry.

[4] *Report of the Committee investigating the strike in steel industries*, Sen. Doc. No. 289, 66 Congress, 1st Session, p. 15.

IV. DETAILED EXPERIENCES OF FIVE PLANTS WHICH HAVE INTRODUCED THE THREE-SHIFT SYSTEM

Chart I shows the three-shift plants. Probably there are other plants on three shifts. Before this study was started there was no exhaustive list of three-shift plants, and the people in the plants themselves usually knew of only one or two other plants which had gone on three shifts. So the method of discovering the plants was largely accidental, and almost up to the end of the study new plants were being found.

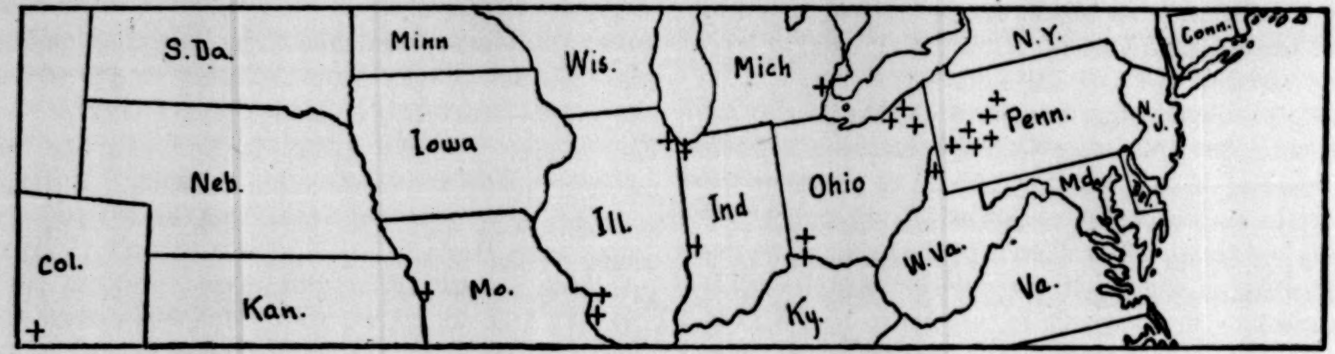

CHART I.

Taking first blast furnaces, the following plants are working blast furnaces on three shifts: The Colorado Fuel & Iron Company, at Pueblo; The Inland Steel Company[1], at Indiana Harbor, near Chicago; The International Harvester Company, at South Chicago; The Ford Motor Company's Rouge River Plant, at Detroit; The McKinney Steel Company, at Cleveland; The Upson Nut Company, Cleveland; The Adrian Furnace, Dubois, Pa.; the Punxsutawney Furnace at Punxsutawney, Pa.; and a furnace or furnaces at Josephine, Pa. This list does not include any plants for California, as I went no further west than Colorado, but it is said that the steel industry of California is on three shifts. The Iroquois Iron Works, a plant of the Steel and Tube Company of America, with several stacks located at Chicago, also operated on three shifts with success for some months preceding the steel strike. Some five of the plants listed above have steel works and rolling mills as well as blast furnaces, and these departments are also on three shifts.

The following plants, which have no blast furnaces, operate open-hearth furnaces and rolling mills on three shifts: The Kansas City Bolt and Nut Company, Kansas City, Mo.; The National Enameling & Stamping Company, Granite City, Ill.; the Andrews Steel Company, Newport, Ky.; The American Rolling Mill Company, Middletown, Ohio[2]; The Trumbull Steel Company, Warren, Ohio; The West Penn Steel Company, Brackenridge, Pa.; Follansbee Bros., Follansbee, West Virginia.

The following plants, having open-hearth furnaces, but no rolling mills, are on three shifts: The Commonwealth Steel Company, St. Louis (works in Granite City, Ill.); The Dusquesne Steel Foundry, Coraopolis, Pa.

The Allegheny Steel Company, Brackenridge, Pa., has its open hearth furnaces but not its rolling mills on three shifts (aside from sheet mills). The Hoosier Rolling Mill Company, a concern having a rolling mill at Terre Haute, operates on three shifts.

In this list of three-shift plants no account has been taken of plants which have only sheet or hoop mills on three shifts, as that is the common practice everywhere, and no account has been taken of plants which have some isolated department on three shifts as is sometimes true of a blooming mill or Bessemer converter.

All these plants taken together make up only a fraction of the steel industry, but they are more than a drop in the bucket; they are widely scattered, they are in all branches of the steel industry, and they are names that are respected. In outlining their experience with the three-shift system, we shall first consider in some detail the experiences of four or five, and then summarize in a more systematic form the combined experience of the twenty.

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[1] Since this paper was presented, the Inland Steel Company has ordered a change from three to two shifts. On the other hand, a number of plants which were running on two shifts at the time this paper was prepared are now operating in whole or in part on three shifts, apparently as a more or less temporary device for relieving unemployment.

[2] The American Rolling Mill Company has also blast furnaces at Columbus, but these are not on three shifts.

1. THE COMMONWEALTH STEEL COMPANY

We shall speak first of the Commonwealth Steel Company, because the company is well known, because it was the first of any of the companies mentioned to go on three shifts,[1] and because we are indebted to a scientific study made by Mr. R. A. Bull, at the time production manager of the company, and later president of the American Foundrymen's Association, for some of the most exact data that has been collected on the relative efficiency of two-shift and three-shift work.

TABLE IV. COMPARATIVE EFFICIENCY TWO-SHIFT AND THREE-SHIFT SYSTEMS

OPEN-HEARTH WORK[1]

(Commonwealth Steel Company)

		12-Hour Shift	8-Hour Shift
General results:			
Extra pig iron charged	(pounds)	556	424
Fuel oil consumed per heat	(gallons)	1275	1138
" " " per ton of metal charged	(gallons)	55	49
Longest intervals between reversal of burners	(minutes)	28	26.7
Cracked castings	(per cent)	0.49	0.37
Chemical tests:			
Maximum phosphorus	(per cent)	0.022	0.018
" sulphur	(per cent)	0.025	0.025
Average carbon	(per cent)	correct	correct
" phosphorus	(per cent)	0.011	0.011
" sulphur	(per cent)	0.022	0.022
" manganese	(points *under*)	2	correct
" silicon	(points *over*)	1	correct
Physical tests:			
Minimum yield point per sq. in.	(per cent *under*)	2.5	(over) 7.7
" tensil strength per sq. in.	(per cent *under*)	4.7	1.4
" elongation in 2 in.	(points *under*)	5	3
" reduction of area	(points *under*)	8.3	7.6
Average yield point per sq. in.	(per cent)	13.0	15.5
" tensil strength per sq. in.	(per cent *over*)	5.9	5.8
" elongation in 2 in.	(points *over*)	4.6	4.1
" reduction of area	(points *over*)	7.9	7.2

[1] Mr. Bull included the material upon which this chart is based in an address delivered in 1912 before the American Foundrymen's Association. It was printed in the Transactions, and reprinted in technical journals, including the Engineering Magazine for January, 1913.

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[1] Since reading this paper I have been advised that the tonnage men employed on two rod mills, a billet mill, and one or more converters of the Joliet works of the Illinois Steel Company went on three shifts in 1898. There was no added cost to the company and for a time the men could not make over laborers' pay. But they stuck to their project, improvements added by the company increased the supply of metal, and eventually production rose considerably. The men are well satisfied with the arrangement, and believe that the management is also.

The business of the Commonwealth Steel Company is the making of steel castings. As foundry work is rarely carried on as a continuous operation,[1] the only department of this company with which we need concern ourselves is the open-hearth department, which contains 4 open-hearth furnaces—though some mention will be made of the boiler room. The Commonwealth Steel Company put its open-hearth department and boiler room on three shifts in 1911. Table IV shows the results of making the change from two to three shifts on the labor efficiency of steel making, in particular as regards the quality of the product, the conservation of fuel and materials, and the efficiency with which the furnaces were regulated. The figures upon which this chart is based were obtained by Mr. Bull by the use of very accurate instruments and tests, and it happened that the study was made under conditions which were unusually favorable for keeping the efficiencies due to the shorter day distinct from those due to other influences.

Most of the open-hearth furnaces now on three shifts have made the change during the last year or two when labor efficiency has been a most variable quantity, due to such disturbing factors as the shortage of labor, the steel strike, and the general demoralization of operation which accompanied the railroad strike. But at the time when the Commonwealth Steel Company made its change there was no wage dispute existing or pending in the Commonwealth plant, or apparently in neighboring plants. There had been no demand for three shifts on the part of the men; in making the change no inducement was offered by the company for the performance of better work; in fact the men did not know that these records were being compiled. Any gain in efficiency shown in the table was, therefore, due almost entirely to the automatic increase in the quality of work which takes place when men work 8 hours instead of 12. In order the more completely to shut out all disturbing factors, Mr. Bull limited his study to the four weeks immediately preceding and the four weeks immediately following the change in shift systems, because in this period no change was made in other conditions about the plant.

By this time those in the audience who are steel men will have observed the nature and amount of the improvement during the later period when the three shift system was in operation. Per cents or points "under" and "over" mean under or over the desired standard, a "point" being one per cent, except in cases of analysis, where it is one-hundreth of one per cent. Those of us who are not steel foundry experts will have to take Mr. Bull's word for it that on examining these figures the management of the Commonwealth Steel Company were greatly gratified to find that on all the essential points the figures showed an improvement.

It was not to be expected, of course, that anything like the full benefits of the shorter hours would be realized at the very start, particularly in advance of any special effort to get better efficiency. Mr. Bull found that on those points where it was possible and fair to extend the comparison another four weeks, the second four weeks of three-shift operation showed a marked gain over the first. Thus in the amount of extra pig iron charged, the weight before the change in shifts was 556 pounds; the first four weeks after the change it was 424 pounds; and the second four weeks 137 pounds.

Mr. Bull's figures deal chiefly with the quality of the product. With Mr. C. M. Cooke, the present open-hearth superintendent of the Commonwealth plant, a man of wide experience in open-hearth work, not only in the Commonwealth plant but in twelve-hour plants in many places—with Mr. Cooke I took up the question as to the way in which the men regarded the three-shift system and also its effect on open-hearth output. Mr. Cooke testified that when once the men get accustomed to the three-shift system they are very much in favor of it and will not go back to two shifts even though tempted by much larger wages. The 12-hour day keeps a man away from his home and family too long. Also on the matter of output, Mr. Cooke testified that while the Commonwealth plant had been on three-shifts since before he went with them, he felt sure, as a result of his experience with both methods of operation, that the output of an open-hearth furnace could be increased 10 per cent within six months of going on three-shift operation. One has to go about it in the right way, however. The men tend, on three shift operation, to run along in much the same manner of working as under two-shift operation, talking, reading the newspaper, sleeping, and in general conducting themselves much as they would at home. As long as all this is allowed the results will not be radically different from what they were before. But by putting an end to these habits and developing in the plant a condition of alertness during the 8 hours while the men are on duty, great changes can be accomplished.

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[1] The Commonwealth Steel Company tried the three-shift system in their foundry, but found that the large amount of cleaning-up necessary about a foundry made continuous operation undesirable. So they now operate the foundry on two shifts of 8 hours each.

Many of the steel men, with whom I have talked, both in two-shift and three-shift plants, have maintained that there is no way of labor's increasing the output of an open-hearth furnace. This would be true, of course, if the furnace were actually running at maximum capacity under two shifts. But Mr. Cook's observation is that the furnaces in 12-hour plants do not really do this. Charging is one operation which can proceed rapidly or slowly; also in the melting process it is possible for the men through negligence or willfulness to cause the process to take longer than it should. So there is a possibility of some increase in output if the management, taking advantage of the shorter day, develops among the men a more effective spirit of cooperation. After about nine years of three-shift management, the Commonwealth Steel Company now has an open-hearth department in which the men are constantly on their toes, by day and by night, watching the furnaces so carefully that the heats are obtained on schedule. Not only is output better, larger, and more regular, but there is a saving of materials, of wear and tear on the furnaces, and a prolongation of the life of the furnaces.

In going from two to three shifts the Commonwealth Steel Company increased the hourly wage rates paid in its open-hearth department by from 16 to 22 per cent.

In the boiler room it was found possible slightly to reduce the number of men on duty at any one time, so that the total wage cost per 24 hours was a few cents lower on three shifts than it had been on two, after allowing for advances in hourly rates of 14 and 19 per cent. Table V shows the way in which this worked out, and also the improvement in the evenness of steam pressure.

TABLE V. COMPARATIVE EFFICIENCY TWO-SHIFT AND THREE-SHIFT SYSTEMS BOILER ROOM[1]

(Commonwealth Steel Company)

	12-hour shift	8-hour shift
Steam pressure		
No. of times when steam pressure fell below 110 pounds	77	42
" " " " " " " " 105 "	9	3
" " " " " " " " 100 "	1	0
Manning		
No. of head firemen required for 24-hour day	2	3
" " second firemen " " " "	3	3
" " coal passers " " " "	3	4
Total no. of men required for 24-hour day	8	10
Total man-hours per 24-hour day	96	80
Increases in hourly wage rates		
Firemen		19%
Coal passers		14%
Labor cost per 24-hour day	$19.50	$19.12

[1] The facts on which this chart is based were also published by Mr. Bull along with the figures quoted in Chart V.

2. THE NATIONAL ENAMELING & STAMPING COMPANY

Located in the same city with the works of the Commonwealth Steel Company is another three-shift plant which includes not only open-hearth furnaces—ten in number—but bar, plate, and sheet mills. The

National Enameling & Stamping Company, which manufactures at its Granite City works the steel required by its chain of enameling factories (as well as steel for the general market) began to go on three shifts not many years after the Commonwealth Steel Company, but unlike its neighbor, made the change gradually, department by department, because the men had asked for it. The National Enameling & Stamping Company is one concern in the steel industry which for many years has dealt with a labor union not only in one but in practically all departments. The change in shift systems was in each case arranged in the course of the annual negotiations with the union. The basis of wage adjustment upon which the men voted to go on three shifts will therefore be of interest.

TABLE VI. DEPARTMENTS IN A STEEL PLANT, AND HOURS WORKED IN EACH, UNDER THREE-SHIFT SYSTEM

(National Enameling & Stamping Co.)

Department	8-Hour Men	10-Hour Men	12-Hour Men
Tin and Sheet Mills	872	83	134*
Finishing Department	124	193	52
Open-hearth Department	151	11	
Universal Mill	129	47	6
Plate Mill	55	51	6
Mechanical Department	234	12	7
Boiler house	69		
General	6	102	6
Total (2350)	1640	499	211

*One department not on three shifts.

Table VI shows the various departments with the number of men in each department working 8 hours, 10 hours, and 12 hours, as things are arranged this year. It will be observed that the shift men are on 8 hours but that the day workers are on 10, with a few odd men who are working 12. The sheet mills, and most of the 8-hour men in the finishing department, have been on 8 hours from the time the company was started. The first departments to make the change from two to three shifts were the open-hearth department and the universal mill, both of which made the change six years ago. The wage adjustment upon which the open-hearth men went on the shorter day was an increase in hourly rates of 12½ per cent. The company figures that the net increase in labor cost for the open-hearth work due to the change in the shift system was about 6 per cent. The output of the open-hearth furnaces has been increased 10 per cent per furnace during these 6 years. The company does not, however, attribute this 10 per cent increase in output to the shorter shift, as other efforts were being made to increase output at the same time. They think it possible, however, that so large an increase in tonnage would not have been obtained had the men not been on the shorter hours.

In the case of the universal mill, the change from two to three shifts was made without any increase in labor cost. This was because there was a substantial increase in output, the output now being 25 per cent larger than it was 6 years ago. Not quite all of the increase in output is due to the change from two to three shifts; but the company estimates that at least 20 per cent increase in output is due to the shorter day. I might add here that I have come across quite a number of plants where output on rolling mills has been increased in just about this percentage, due, the managements say, very largely, to the change to the shorter shift.

The plate mill was put on an 8-hour day one year ago, that is, where it had before run two 10-hour shifts it was arranged to do the work in two 8-hour shifts. About the same production was obtained in 8 as in 10 hours, not because the men worked faster, but because the limited shearing capacity had kept down the amount of work which could be turned out on the 10-hour shift. When the shift was reduced to

8 hours the work was not held back in this way.

In the mechanical department less than half of the men were ever on 12 hours; but those that were (with a few exceptions) were changed from 12 to 8 hours three years ago. There was an increase in cost, but the figures are not obtainable. In the boiler house the increase in labor cost was 10 per cent. This is the only department in the case of which the company does not feel satisfied with the change to three shifts, this being because the company feels that the men are here disappointed over the reduction in daily earnings which the change involved.

In making the change to three shifts, the National Enameling & Stamping Company always increased the number of men 50 per cent, excepting a very slightly smaller increase in the boiler house. The company believes that there are noticeably less accidents among men working 8 hours than among men working 12 hours, and the general impression of the management is that the health of employees is better while working 8-hour shifts than while working 12-hour shifts.

3. THE COLORADO FUEL & IRON COMPANY

Our next illustration will be a large steel company which went on three shifts rather unexpectedly just two years ago, and then found out, somewhat to their surprise, that, in their special circumstances, the three-shift system was a financial saving to the company, as well as a satisfaction to their employees. The Colorado Fuel & Iron Company has a steel plant at Pueblo, Colorado, having 6 blast furnace stacks, 15 open-hearth furnaces, a Bessemer converter, and a variety of mills for rolling blooms, rails, rods, etc., as well as departments for making wire, various wire products, bolts, etc. There are about 6,200 employees.

Under their industrial representation plan the Colorado Fuel & Iron Company has an agreement with its employees by which it pays the same wages as are paid in the east. When, therefore, it was learned in October, 1918, that the Steel Corporation was to introduce the basic 8-hour day, the company promptly called its men together in a series of meetings for the purpose of working out methods for putting the basic 8-hour day into effect. The basic 8-hour day did not, of course, contemplate any reduction in hours, but was simply a wage advance, by which the men were paid time-and-a-half for all work over 8 hours. It happened, however, that after the company had made substantial progress toward arranging with its men for the basic 8-hour day, one of the groups called into conference declared that what they wanted was not the basic 8-hour day but the actual 8-hour day. And it was agreed that this group should have the actual 8-hour day, at an advance in hourly rates of 10 per cent over the base rates prevailing in the East.

A little reflection will show that under this arrangement the men, instead of receiving more per hour than the men in 12-hour plants, would actually, on the average, receive a little less. For under the basic 8-hour day, the steel worker who works 12 hours is paid for 14, an increase of 1/6, on the average, over the basic hourly rates. So where the Colorado Fuel & Iron Company was offering to employ its men 12 hours, at an average increase of 16 2/3 per cent in hourly rates, the men asked that they be employed 8 hours, at an increase of 10 per cent in hourly rates. The 8-hour day meant less than two-thirds of the earnings which the 12-hour day would have meant. Nevertheless, as soon as it was learned that this one group of men had obtained the actual 8-hour day, all the other groups which had already been disposed of came back; and matters soon ended by the whole plant going on 8 hours.

The reason why the company was dubious about the new arrangement was the fear that when the men received their checks they would regret their agreement; but as a matter of fact there was very little complaint. There is no question but that the men regard the winning of the actual 8-hour day as a very great achievement.[1] The company also is very highly pleased with the new system. There is no reason why they should not be, considering the favorableness of the wage adjustment. But, aside from the question of the rate paid per hour, there was prior to the change a good deal of skepticism as to how so unheard-of a thing as the 8-hour day in a steel works would work out. Two years of three-shift operation have proved it practicable.

In view of the fact that the shorter hours were introduced without increase in labor cost to the company, there was no reason to expect that the men would feel under obligation to turn out a larger out-

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[1] The change was not as difficult for the men and their families financially as might appear; for their hourly rates did in fact advance 10 per cent at this time; also, simultaneously with the change from the 12 to the 8-hour day, many of the men went (at their own request) from the 6 to the 7-day week. So actual earnings did not drop so greatly from the previous level; though compared with what the men would have earned had they accepted the offer of the basic 8-hour day, the sacrifice was substantial.

TABLE VII. COMPARATIVE EFFICIENCY TWO-SHIFT AND THREE-SHIFT SYSTEMS
ROLLING MILLS
(Colorado Fuel & Iron Co.)

	36" Mill	Rail Mill	40" Mill	No. 1 Rod Mill	10 % Mill	12" and 14" Mill	12" Mill	20" Mill
Tons per hour								
Jan.—June, 1918	41.42	37.99	31.66	16.54	8.62	9.49	1.69	4.24
Jan.—June, 1919	52.48	47.81	33.90	19.61	9.84	7.95	1.66	3.86
Increase or decrease	+11.06	+9.82	+2.24	+3.07	+1.22	−1.54	−.03	−.38
Per cent	+26.7	+25.9	+7.08	+18.55	+14.15	−16.2	−1.77	−8.95

put, or double up on jobs. So the labor force was increased 50 per cent, wherever the change was made from 12 to 8 hours. So far as the blast furnaces and open-hearth furnaces were concerned there was no increase in output expected or realized. Table VII shows the tons produced per hour on the rolling mills during the first six months of 1918, which came before the change, and the first six months of 1919, which came afterwards.

It will be observed that no gain in production was shown by the 12-inch and 20-inch mills. On the contrary, while the production varied up and down greatly from month to month, the average for the six months' period after the change was a little less than for the six months' period before the change. These mills are an old type of hand mill and the wages paid are the Amalgamated scale, and it was felt by the management that the tradition with regard to the output that should be produced helped to keep these mills about stationary.[1] The 12 and 14-inch mill also shows a falling off in production and there seems to be no good reason why this should have been so. The other rolling mills all show a gain in output, in some cases a substantial one. It should be explained, however, that the increase in production on the 36-inch mill and rail mill, which averaged about 26 per cent, was largely due to the fact that under the 12-hour system the mills had not been well supplied with ingots. Under the 8-hour system these mills were run just two shifts of 8 hours each, and the facilities for heating the ingots are now adequate for keeping the mills supplied for the 8 hours that they now run. So this increase in production was to a large extent only indirectly due to the shortening of hours. The better showing on the three other mills was attributed by the management in the main to the shortening of hours. It will be observed that the best record was made by the No. 1 rod mill, which showed an average gain for the half year of 18½ per cent. These men were on tonnage rates both before and after the change—as were also the men on the 10-inch mill and some of the other mills—and they started out with the determination of doing as well financially on 8 hours as they had formerly done on 12. They did not make it, evidently, but the increase in tonnage was substantial. While the figures show that increased tonnage is a possibility rather than a necessity under the three-shift system, it might be observed that the mills on which there was an increase of output were much more important than those on which output did not increase. In fact two of the latter mills only operate one shift each, and the other only two shifts (of eight hours); so that it turns out that the total shifts operated by the mills which showed increase in production was 13, and the number of shifts on the mills which did not show increases 4.[2]

In considering the eagerness of the Colorado employees to go on three shifts, it should be remembered that the percentage of Americans is about twice as large at Pueblo as in the steel mills in the East, and also that sentiment regarding the 8-hour day is much more pronounced in the West than in the East. Some years ago a state law was passed in Colorado prohibiting the employment of men in smelteries or mines for more than 8 hours, and doubtless the development of sentiment on this and similar occasions helped to prepare the way for the steel industry's going on three shifts.

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[1] An examination of the figures for the separate months would lead one to doubt, however, as to whether there was any planned effort to keep production stationary, or hold to any fixed standard; for, as between months, the record varied greatly, some months showing a large gain, and others a very large loss.

[2] It should be kept in mind, however, that production in steel mills rises and falls for a variety of reasons, and the introduction of the three-shift system was only one of various factors operating. So too much stress should not be laid on these figures. Since they were collected, production in Colorado, as in steel mills all over the country, has, in fact, fallen off—for reasons entirely unconnected with the length of the working day. The last two or three months, however, production has again been rising.

Nevertheless, the experience in Colorado is valuable as suggesting how things might work out if the whole steel industry, instead of isolated plants, should go on three shifts. As long as one's neighbors in 12-hour plants are getting large wages, it is hard for oneself and family to accept a substantial reduction, even though one feels that the shorter day is better. But the Pueblo plant constitutes in itself the steel industry in that part of the country. The time was favorable for a change; in that the lull which followed the armistice was already beginning to appear. Under these conditions, the Colorado Fuel & Iron Company changed over quickly, without special cost, and to the satisfaction of everyone concerned.

As just indicated, it is what those around us are getting that influences our idea of a proper wage rate, even more than our own needs for money. Accordingly, while in isolated plants and localities the employees have often been anxious to go on three shifts, even if they could hope for but little increase in hourly wage rates, in those plants which are in close proximity to steel companies paying large wages for long hours it has been more difficult for the men to see their way to accepting substantial reductions in earnings. The farther East one goes the more necessary it is to keep total earnings somewhere near what they would be in two-shift plants. For this reason, and because neither employers or employees like to see earnings drop suddenly as much as one-third, it has been the usual practice in eastern plants, especially in recent years, to advance hourly earnings somewhere near 25 per cent—and, in a very few instances, even more.

As our last detailed illustrations, we shall turn our attention therefore, to two plants, one of which increased its hourly earnings 25 per cent, while the other has aimed to keep the weekly earnings of the men as high as they had been under the old system. The chief interest in connection with these plants centers about their efforts to keep labor cost from rising.

4. The International Harvester Company

The International Harvester Company, through its ownership of the Wisconsin Steel works at South Chicago, operates three blast-furnace stacks, besides Bessemer converters, blooming and bar mills, a coke works, and various auxiliary departments. At one time two-thirds of the employees were on 12 hours. About 1913 the Bessemer and bar mills were put on three shifts, and in 1919 all continuous processes were put on three shifts. At a later date the 8-hour day was introduced into all departments in accordance with the wishes of the men as expressed through their industrial council plan. There is an arrangement by which each employee gets off one day a week.

In making its wage adjustments the International Harvester Company went just half way with its employees, the men being given just ten-twelfths of what they would get in a 12-hour plant. This 25 per cent increase in hourly wage rates has, however, been partly offset by two things. First, taking the average for all departments, the labor force was not increased 50 per cent. The management went over this matter of taking on new men very carefully with its foremen; it was figured out just what new men would have to be taken on, where they could be obtained, and how they could be trained. Second, there was also some increase in tonnage. Prior to the time when the rail strike introduced abnormal conditions into production the increase in output had for six months run along at a rate which almost, though not quite, kept labor cost down to the former level. Conditions have not been normal for a long enough period to know whether it would be possible permanently to maintain production at a standard that would mean no increase in labor cost.

There has sometimes been difficulty in getting common labor in competition with neighboring two-shift plants, but as regards the bulk of the employees the company feels that it gets a much better pick of men than while it was on two shifts. While the company does not wish to influence other companies one way or the other as regards their shift systems, one of the very last things that the management of the International Harvester Company would consider doing would be to go back to two shifts.

5. The American Rolling Mill Company

The American Rolling Mill Company has blast furnaces at Columbus and rolling mills at Middletown and Zanesville, Ohio. Their three-shift operation is at Middletown where there are two plants which constitute the main works of the company and employ about 4,000 men. They have there 12 open-hearth furnaces, a blooming mill and bar mill, a large number of sheet mills, and allied departments. The management of the Middletown plants have had in mind going on three shifts for a number of years but they waited until they could make the change in the way which seemed to them the right way. To reduce hours, raise prices, and pass the burden on to the consumer did not seem the right way to make things better. So they determined that if they went on the three-shift system they would contrive to do so without raising labor costs, or on the other hand lowering wages.

The Middletown management spent a long time in study before any change was attempted. They called in a firm of outside engineers to act in an advisory capacity, and their own staff began an extended study of the ways in which the number of men might be cut down, or the output of the mills increased. One of their early steps was to call the men of the various departments together, tell them that they were considering introducing the three-shift system, but that their cooperation would be necessary if it was to be a success. The men responded effectively and a great many of the suggestions which were adopted originated with the men on the job.

After careful study and preparation carried on over a period of 7 months, the blooming and bar mills were put on a three-shift basis February 1, 1920.[1] Owing to the careful study made of the manning of the mills, the increase in force was from 200 on two shifts, to 222 on three shifts, an increase of just 11 per cent. The output at times rose as much as 25 per cent, but the average increase over a period of months was 15 per cent. The earnings of the men, who had been placed on a bonus system coincident with the change to three shifts, were as great as they had been on two shifts. The labor cost was at times lower than under the old system, but taking a long view it ran along at just about the level of labor cost as it had been under the two-shift system.

The open-hearth department was put on three shifts about April 1, 1920. Here the extra shift was taken care of by a 15 per cent increase in labor force, the institution of floating gangs being of help. Output was not increased. Certain standards of performance were set up by the attainment of which the men would earn as much money as formerly. However, they have so far fallen short of the desired standards, and are making a little lower weekly earnings than formerly. Labor costs in this department have shown some increase.

In practically all the service departments where the change has been made from two to three shifts, it has required an increase in the number of men of about 40 or 45 per cent. The management hopes, however, that the increase in costs resulting in the service departments and some producing departments will be balanced by the savings in those producing departments where material increases in production have been secured. The net result should be a reduction in overhead cost.[2]

One of the things that the management had hoped to accomplish was a cutting down of various kinds of waste, below the figure which existed under the two-shift system. It yet remains to be seen whether this can be accomplished.

The results so far obtained, though hardly past the experimental stage, are so gratifying, particularly in the rolling-mill department, that it might be thought that the Middletown plants had been over-manned before, or slack in output. There is, however, no reason to believe that this is so. For many years the company has been giving close attention to its labor management, and its organization of officers and department managers has long been a celebrated one through the steel industry. During the war the men on the rolling mills made a point of breaking plant records, and there is every reason to believe that prior to 1920 the plant represented a high standard of two-shift efficiency.

V. SUMMARY OF EXPERIENCE OF TWENTY PLANTS WHICH HAVE INTRODUCED THE THREE-SHIFT SYSTEM

We have gone more particularly into the experience of these five plants because each in their own way they represent some especially interesting aspect of the movement towards three shifts. It is important, however, not to make the mistake of supposing that because things have worked out a certain way in one plant they will necessarily work out the same way in other plants, where conditions may be a good deal different. In the balance of this paper I propose therefore to draw a sort of composite picture of the experience of the entire twenty odd plants which up to this time have gone on three shifts,[1] pointing out what may reasonably be expected of the three-shift system in the typical plant, and finally how things would be apt to work out if the whole industry should make the change.

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[1] The sheet mills had always been on three shifts; the galvanizing department had gone on three shifts about 1917.

[2] The management feels very strongly, however, that the period from February 1 to the present time is not long enough to warrant the drawing of final conclusions regarding the results of three-shift operation. Conditions change so from season to season, from year to year, and between prosperous times and slack, that what does very well at one time might fall short later on. They do not want their hopes, or even what has been accomplished so far, to be taken as more authoritative or final than it really is.

Perhaps the one thing that stands out the most obviously as a result of my visits to and talks with the managers of the three-shift plants is the fact that practically all of them are glad that they made the change. Not that they had no problems to meet, but they were in practically all cases looking ahead, not back. In going around I now and then heard of a plant which had been on three shifts and gone back to two, and at first I thought that here I would learn the reverse side of the story. I made a practice of going out to such plants—the number in recent years has not been great—but I did not find them to be centers of dissatisfaction with the three-shift system. I found that in a good many cases where it was said that plants had gone back to two shifts it was not so, and in the few cases where they had done so, the reason when inquired into usually proved to be some more or less accidental thing; and I can remember only one plant where there seemed to be a deliberate going back bcause of a feeling that the two-shift system was more satisfactory. Of course I have been studying present-day conditions, and not the history of shift systems several years back; so I cannot speak with authority regarding possible changes from three to two shifts under the war and prewar conditions. But I do feel confident that the very general satisfaction which managers have expressed regarding their experience in passing from two to three shifts is not balanced by any parallel movement of consequence from three shifts to two.

Equally important with the attitude of the managers is the attitude of the workers. It has often been pointed out that one of the difficulties involved in changing the steel industry from the two to the three-shift system is the fact that the men do not want to work the shorter hours. I have made it a special point to talk this phase of the situation over with the managers, and to argue about it with other persons who I thought could speak for the men, and I am firmly convinced that in times past this has been a very serious obstacle to the introduction of the shorter day. There have been large numbers of foreigners who would just about as willingly work 12 hours as 8, and who would much rather earn 12 hours pay. And there have been many others who from pressure of circumstances or because of habit were willing to work 12 hours a day while work was to be had. But with the coming of the war the foreigner found his egress to Europe cut off, and he began to think of America as a place where he would stay a while. So the men became more interested in their surroundings and by the time the steel strike had reached its height there must have been a tremendous amount of dissatisfaction among steel workers with the 12-hour day. This change of sentiment due to the growing Americanization of the foreigner, and also to a considerable increase in the number of American-born employees, was evident in the background of things in most parts of the country which I visited.[2] It would not be correct to say that there was no longer a problem in convincing the men to accept the shorter day. I found that it existed to a greater or less degree in almost every plant which I visited. But where the management is disposed to make reasonable concessions in the matter of hourly wage rates, the majority of the men soon fall in line as definitely favoring the shorter day. You will never get all people to agree on any one thing, and there will always be a few persons who would like to work all the time, as the business man does; and there will be many who are more or less torn between the desire for short hours and that for large money. The plants which have gone on three shifts sometimes lose a certain element in their labor force, usually from among the lower paid labor and the immigrant labor. But the difficulty is not large, and after the men have once got used to the three-shift system you could not pull it away from them with tongs.

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[1] I visited personally or talked with the managers of about 16 or 17 of the 20 plants.

[2] Any generalization is, of course, rather dangerous for an industry located in as many different states and employing as many different types of men as the steel industry. I have tried to give the general consensus of opinion regarding the results of introducing the three-shift system in the 20 plants, pointing out the exceptional cases where they seemed important. Among close students of the subject there is, however, more or less disagreement regarding the precise attitude toward the 12-hour day of the foreign workers at present employed in two-shift plants. Probably that attitude will never be known with certainty until the three-shift system has actually been tried out among these groups.

The main question that has seemed worth while looking into as regards the three-shift system has been the fundamental question as to what extent if any the greater wage cost due to compromise on hourly wage rates at the time hours are shortened can be offset by increased efficiency; that is, to what extent can the shorter day be made to pay for itself.

A survey of the plants which have been experimenting with three shifts shows that the attainment of this goal is not a simple matter. Most of the people with whom I have talked were ready to agree that as a general proposition—having no special reference to the steel industry—8 hours or 10 hours makes a better day from the production standpoint than 12 hours. Where the amount of work accomplished depends on the energy that a man puts in, it is believed that he will do as much in 8 or 10 hours as in any longer period.[1] But while the steel men feel that this is true in most industries and in a few departments of the steel industry, they do not believe that in the steel industry taken as a whole a day as short as 8 hours can actually be made as productive per man-day of 8 hours as is the present day of 12 hours; for the reason that most of the work around a steel plant is not of a kind that a man can pitch into and get done. He must wait. I found, as a matter of fact, that in almost all cases the three-shift system is being introduced at some increase in cost—that is, in cases where the men do not go on at practically the same hourly wage rates as before. And it seems likely that if all the steel plants in the United States were to go on three shifts a large majority would find that their labor costs had risen.

It is not so certain, however, that this increase in cost would prove to be permanent, at least in its entirety. In speaking of their experience with three shifts, managers have constantly given the warning that conditions have not been normal during the last few years when most of them have made the change, and that it is hard to tell just what would be the results under more favorable circumstances. During a period of labor shortage, when jobs are more numerous than men, it is hard to get men to change their habits, or to do more work, even if the conditions and pay are such that they could well afford to do so. Moreover, most of the plants changed over shortly before or sometime since the steel strike; and, needless to say,

TABLE VIII. CONDITIONS UNDER WHICH THREE-SHIFT SYSTEM WOULD INVOLVE NO INCREASE IN COST OVER TWO-SHIFT SYSTEM

	Changing hours of shift workers from	And increasing men's hourly rates 25%		But taking on only 35 % more men		Would mean a small increase in daily payroll for shift men	If daily output is on the average increased 10%	Labor cost would remain practically stationary
		Rate per hour	Wages per day	On a shift	Per day			Per ton
Two-Shift system	12 hours to	60c	$7.20	10	20	$144.00	170 tons	$.85—
Three-Shift system	8 hours	75c	6.00	9	27	162.00	187 tons	.86+

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[1] In the course of this study I have run across two plants, one in the East and one in the West, which have tried Lord Leverhulm's plan of four 6-hour shifts. In both cases the managing heads were enthusiastic over the results; for to their amazement (neither had heard of the other) the men in both cases produced more in 6 hours than in 8; and, considering the fact that both plants had expensive equipment, the saving in overhead was decisive. The achievement is not so incredible as it sounds, for a man can work through a 6-hour shift without any interruption, while during an 8-hour shift he is interrupted and slowed down by at least one meal. The head of the one plant had got much better results on the shift from 12 midnight to 6 A. M. than had been attained on the similar 8-hour shift; while the manager in the other plant had found that during the hot months, when he tried the plan, the proportion of turns when the men did not report for work was greatly reduced. One of these plants was a sheet mill and the other a fabricating plant where welding plays an important part. The managers of these plants would be the last to claim that what had worked out with success in their special departments would work in the steel industry in general, where the jobs consist so largely in simply standing by. Since presenting this paper I have learned of another plant in a metallurgical industry (not iron or steel) in which the men work 6-hour shifts; but the four shifts are divided among three groups. A man works 6 hours, is off 12, on 6, etc. This mutual arrangement was the wish of the men.

that was a very potent source of demoralization. Some of the plants started up operation with an almost entirely new force of men, and it would naturally take several years before such a new force would do as well, other things being equal, as before the strike. Then last summer there was the rail strike, which made operations irregular, affecting the supply of fuel, materials, etc. Comparative statistics are therefore of very little value in many cases; and even the general impression made on the managers, and the reaction upon the men, is not what it would have been under less adverse conditions.

TABLE IX. MAXIMUM COST OF INTRODUCING THREE-SHIFT SYSTEM INTO A BLAST FURNACE ASSUMING THAT HOURLY WAGE RATES ARE ADVANCED 25 %BUT THAT THERE IS NO INCREASE IN EFFICIENCY

Total labor cost of making a ton of pig iron	$1.25 a ton
Proportion of labor cost paid to present 12-hour workers (2/3)	.83 a ton
Increase of 25% in pay-roll of shift workers	.21 a ton
Selling price of a ton of pig iron	$40.00 a ton
Cost of ore required to make a ton of pig iron (2 tons ore)	16.00 a ton
Maximum cost of abolishing 12-hour day (assuming no increase in efficiency or elimination of jobs)	.21 a ton

Another important thing to take into account is the fact that in the average steel plant, which makes the change from two to three shifts in a more or less routine way, the economies possible under the system are fairly certain not to show themselves to any great extent at the start. The mere change from 12 to 8 hours in an industry where everything centers around huge machines and furnaces is simply an opening of the door for greater efficiency, not a consummation of it. What is necessary if the industry is really to get what it should out of the shorter day, is a thorough-going reorganization. The occupations must be changed, the spirit of the men, the type of foremen. What the introduction of the three-shift system does is simply to open up a new country. Some gains will come automatically without labor. But before any fair census can be taken of what the new country can produce, it will be necessary to plow the land, put the best kind of seed in the most fertile places, and in general strive for something. The shortening of a man's day from 12 to 8 hours means that the possible energy and attention which he can put into his work in each working hour is greatly increased. But to harness this new energy, as to develop a new country, will take time.

There seems, in fact, to be substantial reason for believing—in view of results already accomplished in some of the plants—that when the three-shift system once gets into fair running order, the labor cost need not be to any great degree higher than it has been under two-shift operation; and, indeed, a rather fair argument might be drawn up to show that all of the increase in labor cost might in time be wiped out. Table VIII is an illustration of a situation under which, if it could be obtained, steel would be made at substantially as low a labor cost under the three-shift system as under the two-shift system. If hourly wage rates are compromised half way, the force of men increased not a full 50 per cent, but on the average 35 per cent, and if output could on the average be increased 10 per cent, then the labor cost under three shifts would be practically the same as under two shifts. If the first figure were 20 per cent, or the second 30 per cent, or the third 12½ per cent—in each case the other two figures being unchanged—there would be no increase at all.[1]

The experience of practically all the plants which I have visited shows that the wage adjustment specified is a feasible one. Where it is expected that the men will turn out a greatly increased output, or where there is a very material decrease in the number of men, it would be only justice to give the men perhaps as much for 8 hours as they had previously earned in 12. In that case there would of course be no difficulty about labor costs. But assuming that we are not so fortunate as to be able to realize any very large increase in efficiency, it has been shown that the men see the reasonableness of paying for their greater leisure by some reduction in total earnings. This figure of 25 per cent is the maximum that would be required even under conditions of labor shortage.[1]

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[1] I wish to make it clear that this table does not represent the *average* accomplishments of the 20 plants. The figures were selected to show what would be necessary to eliminate all increase in cost; and we then go on, in the paragraphs that follow, to consider how closely these figures can be and are approximated.

The figure for a 35 per cent increase in men, instead of 50 per cent, is also a conservative one. In many plants exactly 50 per cent more men are employed on three shifts than on two, and most of them are close to the 50 per cent figure. But the 35 per cent standard has been attained by such large plants as those of the International Harvester Company and Inland Steel Company, and a much better showing was made by the American Rolling Mill Company. It might be noted that the limitation to 35 per cent increase can be obtained, if, where 10 men are now employed on a shift, it is possible to get along with 9. That is, 27 men employed on three shifts is just 35 per cent more than 20 men employed on two shifts. It seems only reasonable to assume that with so large a reduction in the number of hours, it would be possible to cut out one man out of ten.

The figure for increased output of 10 per cent seems not very far away as an average. It is of course too high for a blast furnace. I know of no reason to expect greater output at all from a blast furnace on three shifts, unless it was before very badly handled. Fortunately in the case of a blast furnace the labor cost is small. In the case of the open-hearth furnace a 10 per cent increase in output would be an ambitious program. Many steel men would say that any increase in output at all would be impossible. Others think that wide-awake labor can hasten the charging and guarantee that the melting takes place at maximum speed. Fortunately about an open-hearth furnace there are ample opportunities for improving the quality of the steel, prolonging the life of the furnace, and saving in materials, which may more than make up for the difficulty of increasing output. As regards rolling mills, the human equation enters in to a considerable extent, so that increase in output may be looked for. The amount depends on the type of mill and the opportunities for doing more rapid work. It would also depend some on the efficiency of the arrangements for supplying the metal to be rolled, and for shearing and taking away the finished product. On many mills, however, actual figures show that the increase in output may run up well toward 20 per cent, or even higher.

Such calculations as we have been considering make the goal of eliminating increase of labor cost under the three-shift system seem not altogether out of the range of attainment,—and, indeed, individual companies have in some cases just about reached the standards suggested—though average accomplishment is still considerably lower. But the striking feature of the whole question of cost is the fact that whether plants do well or badly the increase in cost involved in going on the three-shift system cannot at the utmost be very serious. Suppose that there were no increase in efficiency at all, that a plant increases its force of shift men precisely 50 per cent, that the output is no greater in any department than under two shifts, and that the hourly wage rates are raised 25 per cent. Table IX shows the maximum possible increase in labor cost so far as the making of pig iron is concerned.

In a good blast-furnace plant, the labor cost at present wage levels and efficiency should not be far from $1 a ton, to be safe we will say $1.25 a ton.[2] Assuming that the change from 12 hours to 8 would affect 2/3 of the men, the pay of these men under the two-shift system would amount to 2/3 of $1.25 or 83 cents per ton. An advance of 25 per cent in the hourly wages of these men would increase the labor cost per ton of pig iron by 21 cents. Considering the fact that pig iron sells for around $40 a ton,[3] that the ore that goes into a ton when delivered at Pittsburg costs about $16, the trifling risk involved in increasing the labor cost a maximum of about 21 cents is apparent.

Likewise in open-hearth work the labor cost might be $1.30 a ton, to be safe we will say $1.50 a ton. The maximum increase in labor cost here, assuming no increase in efficiency, would be 25 cents. Thus the total increase in labor cost for the steel ingot would be not more than 46 cents, still a small figure for something that sells for about as many dollars.

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[1] The evidence is not altogether satisfactory as regards the Pittsburg district. The three-shift plants located near Pittsburg are small compared with the district's two-shift plants and some of the managements have gone more than half way in the matter of wage adjustment.

[2] We are speaking here of blast furnaces which are a part of large steel plants. In the case of isolated furnaces, or those not having modern ore handling, charging, or pig casting machinery, the cost might well be considerably higher than the figures here given.

[3] At the time of writing. Earlier the price was considerably higher. Since the presentation of this paper it has dropped to considerably below $40. Wages also have tended downward.

In the rolling mill, the labor cost will run higher, especially where material is rolled several times, and into light shapes, such as rods, plates, etc. This might, indeed, be an advantage rather than a disadvantage, for in proportion as the product is put through many processes, the opportunities for getting higher labor efficiency and increasing output multiply. So that in various rolling mills visited the three-shift system meant no increase in labor cost.

Nevertheless, assuming that there is no increase in efficiency in the rolling mill or elsewhere, exhaustive analyses made by the government have shown that if every department of a steel plant were put on three shifts the total cost of producing steel products, including blast-furnace, open-hearth furnace, and rolling-mill work, could not on the average be increased more than about 3 per cent.[1]

While with good management, there can be no question but that the increase in labor costs may be kept well below the maximum figures given above, it must be evident that we are after all dealing here with a rather unimportant aspect of the making of steel. As a matter of fact the managers in the steel industry are not worried a great deal one way or the other about this 21 cents for pig iron or this slightly larger amount for open-hearth steel.[2] I think that probably the real reason why nearly all the three-shift manufacturers with whom I spoke were in favor of continuing on three shifts was because of those not easily measured efficiencies that spring out of the spirit of the men. I kept asking managers why they were in favor of three shifts. They had said that it cost more. I think that many of the manufacturers were influenced somewhat by humanitarian motives; but beyond this they kept saying that they also regarded the three-shift system as better from a business standpoint.

The fact is that the actual labor cost is not the decisive factor in the steel industry that it is some places. The main expenditures are for equipment and materials. What is of importance is that the equipment be kept up, and that the processes proceed without mishap. As a Chicago steel man, whose plant went from three to two shifts about a year ago, but who was personally in favor of three shifts, said, it is now much more important than formerly to have responsible, watchful labor in the steel industry. There was a time when the men were occupied in shoveling ore that was to go into the furnace, or preparing the sand casting beds, when the men could pitch in and work hard for a time and then take it easy. Now nearly all of that intermittent manual labor is gone, the gangs have been cut down to almost nothing, and those who are left are in more responsible positions, not doing much hard manual work, but watching over vast and important processes. This more continuous duty is in a way more of a strain than the old intermittent work, and the men do better on 8 hours than on 12.

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[1] Sen. Doc. 110, 62 Congress, 1st Session. *Report on conditions of employment in the iron and steel industry*, vol. iii, pp. 175-187. The 3 per cent estimate is based on very exhaustive studies made by the Bureau of Corporations and the Bureau of Labor, relative to the cost of making merchant bars, wire rods, structural shapes, Bessemer rails, and sheared plates, these products constituting two-thirds of the country's steel products. Sheet and wrought iron were omitted from the analysis as the departments making these products were already working substantially 8 hours. Two sets of figures are given, one assuming a 25 per cent increase in hourly rates, and one a 50 per cent increase. I have taken the 25 per cent figures. This study, which is the most recent comprehensive analysis of the subject, was unfortunately made as long ago as 1912. If during the last ten years (shift-) labor costs have risen out of proportion to total costs, including ore, coke, transportation, repairs, and (in the case of the later operations) pig iron and ingots, then the figure of 3 per cent would be too low. So far as the making of pig iron is concerned. I feel fairly certain that no such disproportionate increase in labor cost has occurred. As to whether there has been a disproportionate increase in the labor cost in the case of the open-hearth furnace and rolling mills, a good deal would probably depend on how far labor efficiency has fallen off, and how far this has been made up for by the increased use of labor-saving machinery. The actual maximum figure would, of course, move up one year and down the next, and would vary greatly in different plants. Whether or not 3 per cent is the exact average for this year it might be hard to tell; but we may feel sure that the maximum would fall somewhere in that neighborhood.

I find that steel men can hardly believe that this figure could be as low as 3 per cent. While not personally responsible for the estimate, having obtained it from the report referred to, I think it cannot be very far wrong. For the figure to come out 3 per cent it is only necessary to assume that the proportion of labor cost (going to *turn* labor) in the steel industry is one-eighth of the total cost. (For if one-eighth of the cost be increased by 25 per cent, the total increase in cost would be one-thirty-second, or almost exactly 3 per cent.) It should be a fairly easy matter for any manufacturer of steel to determine the proportion between his total pay-roll paid to 12-hour turn men and his total costs, and he can then tell for himself whether 3 per cent is too large or small for his plant.

Judge Gary, speaking for the U. S. Steel Corporation, declared that 26½ per cent of the Corporation's employees work 12 hours. If now the total pay-roll of the Steel Corporation were just half of the total cost, including such items as royalties, freights, materials purchased, interest, depreciation, repairs and any other charges not payable to the Corporation's own labor, then the cost for shift labor employed by the Steel Corporation would not be far from one-eighth of the whole; and the cost of a 25 per cent advance made to these men could not be far from 3 per cent.

By the extent to which these assumptions vary from the true condition, the reader can tell how near or remote the 3 per cent figure may be.

[2] The maximum increase in cost referred to in the preceding paragraph (3 per cent) is much smaller than the normal range in steel prices during the course of a calendar year. In fact, a differential greater than this has been existing on the same date between the price asked by the Steel Corporation and those asked by the "independents."

What is true of blast furnaces is much more true of open-hearth work. The author of a text book on metallurgy has told me that it is possible to make almost as good steel in an open-hearth furnace as in an electric furnace; but American open-hearth practice is very far from that attainment. Also the open-hearth furnace is a rather delicate mechanism which has to be rebuilt every once in a while, and it pays to give it good care. It is also easy to waste fuel and materials, and to destroy or lose tools.

I found that in most cases steel manufacturers had not, in fact, found that the three-shift day had brought any marked improvement along these lines; perhaps, they thought, because of the confused labor condition in the industry. But they had noticed a marked improvement as regards absenteeism, and a tendency towards a better spirit. And I have no doubt but that, in general, the manufacturers feel that in the course of time, if not already, they will find it more satisfactory to have their works in the charge of men who, from the superintendent down to the helpers, are alert and on their toes all the time they are on the job, rather than men who go along in the easy-going way which all agree has been characteristic of the two-shift system. There are some notable examples of plants whose experience strongly supports this faith in the greater dependability of foremen and men who work the shorter hours.

Considering also the fact that, now that the 12-hour day is getting to be a good deal of an anachronism, there is no telling what difficulties might arise in the industry if it is continued, there are a good many steel manufacturers who believe that in the long run steel will not cost any more, or maybe not as much, under the three-shift system as it would if an attempt were made to continue the two-shift system.[1]

In passing, one word should be said about what the men do in their leisure time. A good many people not in three-shift plants are worried about that. The managers of three-shift plants are not worried. Those extra four hours have been swallowed up as easily and unnoticeably as were the bar keepers. What the men do, depends on what they are interested in. Some few are the worse off, though it is doubtful if they are any worse off for four hours of extra time every day, than they would be for a day or two taken off irregularly under the old system. The majority of the men seem to profit by their free time; though the managements do not find the problem one to which they need to pay any special attention.

VI. THE THREE-SHIFT SYSTEM IN THE STEEL INDUSTRY AS A WHOLE

Having considered the conditions under which the three-shift system has been and may be introduced into individual steel plants, it remains only to say a word with regard to the special problem presented by making the change, not in a few plants, but in the steel industry as a whole. Is that possible of accomplishment? How long would it take? And in what respects would the problems and results be different from those encountered by individual plants?

In September I was told on all sides by the managers of plants which had gone over to the three-shift system that while they had encountered no special difficulty in getting the extra men needed themselves, it would be impossible for the industry as a whole to go over to three shifts because there was not a sufficient supply of labor trained in the steel industry in the country to run the extra shift. While it is easy to exaggerate the difficulty of quickly finding and training men—some marvels along this line were accomplished during the war—I believe there was until a few months ago a good deal of reason for this feeling. Today, however, these same steel manufacturers say that with the easing up in the demand for labor and with the tendency towards slack times in the steel industry itself, the time has already come or will come exceedingly soon when the whole industry could go over to three shifts without serious difficulty. In other words the time is now here, for which men in the steel industry have for several years been saying that they were waiting, to introduce the three-shift system.

The three-shift system can be introduced by the manufacturer more easily and at less cost to himself now than at the time when the plants now on three shifts made the change. Not only will the men fall in with plans much more readily than they would have a few years or months ago, and with more moderate expectations with regard to increases in wage rates, but it would be much easier for the manufacturers to persuade labor to increase its efficiency so as to offset to a considerable extent the increased labor cost. This is a time when men like to be worthy of a job. What more appropriate than that the shortening of hours and the effort to increase efficiency should go together!

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[1] It is important to note that in order to keep costs from rising it is not necessary that output be as great in 8 hours as in 12, or that there be other equivalent gains in efficiency. One very important assumption that has underlain all our estimates (and justifiably so) has been that the men will help wipe out the increased cost by themselves accepting some reduction in daily earnings. It is just as reasonable that 12-hour men changing to 8 hours should give up a part of the large earnings of 12-hour work, as it is obvious that men who had been working 8 hours would expect extra pay if they were compelled to work 12 hours.

There is, of course, almost sure to be added expense, and a great deal of extra work for the management, at the time when the change from two to three shifts is being made—especially if there is any consistent effort to adjust wages or get greater operating efficiency. We have been speaking here of long-run results.

If the bulk of the steel industry should at practically one time change from two to three shifts, the most commonly advanced objection to the shorter day would lose almost all its force. And that is the objection that the men want the maximum earnings given during the long hours. I believe that the Senate Committee was right when, after holding hearings in Pittsburgh, they concluded that the majority of the steel workers were opposed to the 12-hour day. Yet the comparatively few who are still in favor of long hours can cause some perplexities where an individual plant adopts the three-shift system but is surrounded by 12-hour plants. This source of irritation and confusion would, of course, not exist at all if the steel industry as a whole, or in great part, should go to three shifts.

The magnitude of the problem of finding the extra labor is not nearly so great as is commonly supposed. As for the higher positions, these may be filled by promotion of helpers. This promotion in itself has a favorable effect on the men, as the better workers make up in promotion for what they would otherwise lose because of shorter hours. The lower positions may be filled by new labor.

However, under present conditions, the time may soon be at hand when the three-shift system could be introduced, without bringing any new labor into the industry. If indeed we are face to face with a time of considerable unemployment in the steel industry, then this would be the time of all times to cut out one man's working 12 hours a day, and another's working not at all, and distribute the work so that all would have employment for a reasonable workday. Under these conditions the change can be made with the greatest of benefit all around, and perhaps no cost anywhere.[1]

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[1] In the slack period which fell upon the steel industry following the armistice, three large companies introduced the three-shift system without any increase in hourly rates over what the men would have received in 12-hour plants—in fact, in two of the plants the rates were less. And, under the conditions then existing, the employees fell in heartily with the arrangement. Perhaps it would be unfortunate for the three-shift system to come in without any increase in hourly rates; because there would then be less encouragement to the employees to cooperate in securing that greater efficiency which should attend the going to a shorter day. Nevertheless, if, during a period of slack employment, it were a choice between employing a smaller number of men 12 hours, or a larger number of men 8 hours, it is hard to see but that, regardless of the hourly rates, it would be better, both from the standpoint of employer and employee, to adopt the shorter day. At the present moment the three-shift system might, therefore, slip in with practically no cost, except that of planning the new schedule of work.

In the body of the paper I have hesitated to emphasize this aspect of the situation because it might be said that this could be at best only a temporary arrangement; or because the employers in the industry might themselves desire to do better by their men in making the change than is here suggested. Also it might be said that the alternative to the three-shift system at present hourly rates, is really the two-shift system with a cut.

However, taking the longest possible view of things, is it not true that the idea that two shifts are cheaper than three rests first of all on the assumption that men will be willing to work 12 hours for less than 50 per cent more money than they would insist on having for 8? In the past, when long hours were customary in many industries this assumption was doubtless well-grounded. But as the 12-hour day becomes more and more an unusual thing it seems unlikely that any large body of men can be prevailed on to work 12 hours unless they get substantially more compensation than do their friends who work 10 or 8. When the hourly rate is as high for 12 hours as for 8 (and we may have reached that place already) there is no possible economy in the two-shift system.

While the growing slackness in the steel industry makes the present time more and more the ideal one for making the change from two to three shifts, it will still require some courage, and probably some waiving of immediate gain for an employer to go to three shifts. The employer who is disposed to press every temporary advantage to the utmost may reason that now is the time to make a large cut in hourly wage rates, and that this will go better with the men if hours are lengthened rather than shortened: if this policy should create greater unemployment, it will simply give the employer a greater leverage to force wages still lower.

But vindictive attacks of capital on labor, as of labor on capital, are not going to increase the stability of the industry or the reputation of employer or employee. What the situation calls for is a somewhat smaller reduction in hourly rates than would otherwise be made (if reductions are indeed in order) and simultaneously a redistribution of work among a greater number of men on the basis of a reasonable working day.

Even if the men should not receive so much per week under this arrangement as under the 12-hour day, there would be less suffering in the steel community, and probably an earlier return to stable industrial conditions, conditions which would at bottom be considerably more sound than they have been in the past.

VII. DISCUSSION

1. By Fred J. Miller[1]

I think I may best start the proceedings this evening by relating something of a strike which took place in one of the large steel works of this country in 1910. It concerns the twelve-hour day and Sunday work, and the incidents connected with it have some lessons that I think we might well consider in connection with the subject to be discussed this evening.

This strike was brought about by the summary discharge of three members of a committee who had been selected by their fellow machinists in the steel works to protest against Sunday work, and to request that it be abolished altogether. This committee had been appointed because the machinists, though they worked normally six days and a total of fifty-four hours and a fraction per week, had been required to work on Sundays until, as workmen always do, they became thoroughly tired of it and wished to avoid it as much as possible. In order to do that one of the men, noting that when they were required to work on Sunday they were notified on the previous Saturday, absented himself from the works on Saturday so that he wouldn't receive the notice to work the next day. Then when he came back to work the next week he told some of his companions what he had done and for what purpose. Upon verifying this the foreman immediately discharged him.

This committee of three men was chosen to protest against the discharge of that man and to ask that Sunday work be discontinued. The committee was thereupon summarily discharged by the management and that brought on the strike.

As the Government was having work done in that establishment at that time—I think armor plate for the Navy—a resolution was introduced in the United States Senate to investigate this strike, something of its causes and the incidents that led to it. The foregoing facts are taken from that report, which further states that at the beginning there were no union men concerned in the strike, although recruiting for the unions went on rapidly after the strike began.

It says that the local police were in sympathy with the men and did not take the proper measures to preserve order in the streets as they should have done. The state police were called. There was rioting and trouble; one man was killed from a shot fired by a state policeman, a number of men were injured and the bitterness engendered by that strike, I have reason to believe, still exists in that institution.

Now, we may perceive that there were several things in connection with that strike that may interest us. To begin with, it shows, as has been shown elsewhere before that strike and since; that serious labor trouble may occur where labor unions take no part in it. In other words, men can be brought together for adverse action and to make war or to follow the methods of war without joining a union. It has happened many times and can happen again.

Another lesson is that where a committee appointed serves voluntarily in the interests of their associates, whether that committee be composed of working men or whether it be composed of business men or lawyers or any kind of men, if that committee acts in the interest of their companions and of their class, then the people on whose behalf they act will not submit to discrimination or injury being done them without a fight. That has always been so and it will be so so long as workmen retain any of the elementary principles of manhood. No group of employers would allow an injury to be done to voluntary representatives of theirs in a negotiation of that sort if they could possibly help it. They always resist it and fight against it for such is the nature of men. It is human nature for a busy executive, harassed for production and so on, to resent the interference of men whom he calls "disturbers" and regards as the cause of all the trouble. He imagines there would be no trouble were it not for these men who have waited upon him to adjust the trouble. He thinks they have stirred up trouble that would otherwise have been non-existent. That is nearly always a mistake

No agitator can get very far unless behind him there is some cause for a grievance or for feeling that things are not right. That cause is not always justified. There may be a misunderstanding or something of that sort. But I think it is safe to say that a considerable proportion of the men at least must always believe, sincerely, that there is some real cause for complaint and grievance; or else your "trouble maker" and your "agitator" can't get very far.

I speak from practical experience and observation on this point. It isn't merely a theory with me, it is the result of much observation and a good deal of practical experience in that line.

Another point is that the public will be probably increasingly interested in industrial disturbances. In the first place, our industries are now being carried on increasingly by large corporations. Corporations are created and are maintained by the authority of the people. The people may depend upon them for imperative necessities of modern life. The people are responsible for the maintenance of law and order when these outbreaks occur. They must usually contribute to the support of people whose means of subsistence are suspended or destroyed by these upheavals. And they have in most cases maintained, by means of tariffs, prices for the corporation's products, higher than the free working of economic laws would provide. They are for these and other reasons partners in interest to all that a corporation does or does not do that affects the public welfare.

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[1] President of the American Society of Mechanical Engineers. Mr. Miller presided at the joint session at which Mr. Drury's paper was presented, and these remarks were the introduction of Mr. Drury and not a discussion which followed the presentation of the paper.

It is, we believe, a proper function of the engineer, standing as he does between the employer or the corporation on one side and the men on the other, to throw all the light possible upon these involved and difficult questions. He occupies a more or less detached position. He is usually an expert and knows the meaning of the things that he is seeing and can understand their bearing upon the question. He is relatively free from prejudice on either side and may be entirely so.

At the recent meeting of engineers at Washington this new function of the engineer was emphasized and brought strongly to the forefront, and it is the object of this meeting to throw additional light upon this matter of the twelve-hour day and of Sunday work, and to discuss it with a view to having it better understood than is generally the case.

To that end I have the pleasure of introducing a gentleman who has been making a study of the three-shifts system in the steel industry, and who will now make his first report to the engineering profession.

2. By Robert B. Wolf[1]

In talking on the technique of changing from a two-shift to a three-shift day in a continuous process industry, my task is to throw light on the steel problem by presenting accomplished facts in another industry, —the pulp and paper industry. It is assumed you are interested in actual experience and prefer to more or less draw your own conclusions, based upon the facts presented. I will, therefore, start my talk by showing figures and charts in three plants, which I changed over from a two-shift to a three-shift basis. For obvious reasons I have left off the names of the three companies, but will gladly give information as to the exact place of operations to anyone who cares to go into the matter further.

It has been suggested that I not only give you concrete experiences, but also the conclusions we drew from these experiencs. I will, therefore, divide my talk into seven headings, as follows:

1. Actual illustrations of the results obtained in three plants where the change was made.
2. An interpretation of these results.
3. Illustrations of how the shifts were actually rotated.
4. The change in management policy which should accompany the change to three shifts.
5. Proposed further changes being considered in the pulp and paper industry, based upon past experience.

Actual Experience

Under this heading I wish first to submit Chart A, which shows the operation of a sulphite pulp mill from its start in November, 1902, to February, 1906. This chart shows the production in tons per month and also the labor cost per ton, this labor cost including nothing but that labor actually used in the mill itself for converting wood into pulp.

The change from two to three shifts took place some time during the year 1904 and while my own records as to the time of the change are not complete, nor are the records of the company that now owns the mill complete enough to state the exact month, still, as near as I can get at the time of the change, it was during the latter part of the summer of 1904, where the X is shown on the chart. You will note that the labor cost per ton shows practically no increase and as I was superintendent of the mill during this period, I know from actual experience that the increased production shown was because of the better spirit we obtained all through the plant when our men were not being overworked, as was the case with the long eleven and thirteen-hour shifts.

Table I gives the actual increase in the number of men when I changed over another mill from a two to a three-shift basis. This mill was much larger and because it was very complicated and the equipment in poor condition, it was necessary to increase the number of men very materially. You will note the tour workers increased from 336 to 455, a total increase of 119 men. The day workers, which numbered 200, were not, of course affected. The actual

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[1] Consulting Engineer, New York. Mr. Wolf's discussion is a repetition of an address delivered before the Engineers' Club of Philadelphia (printed in Vol. XXXVII—12, No. 192, of the *Journal* of that Club).

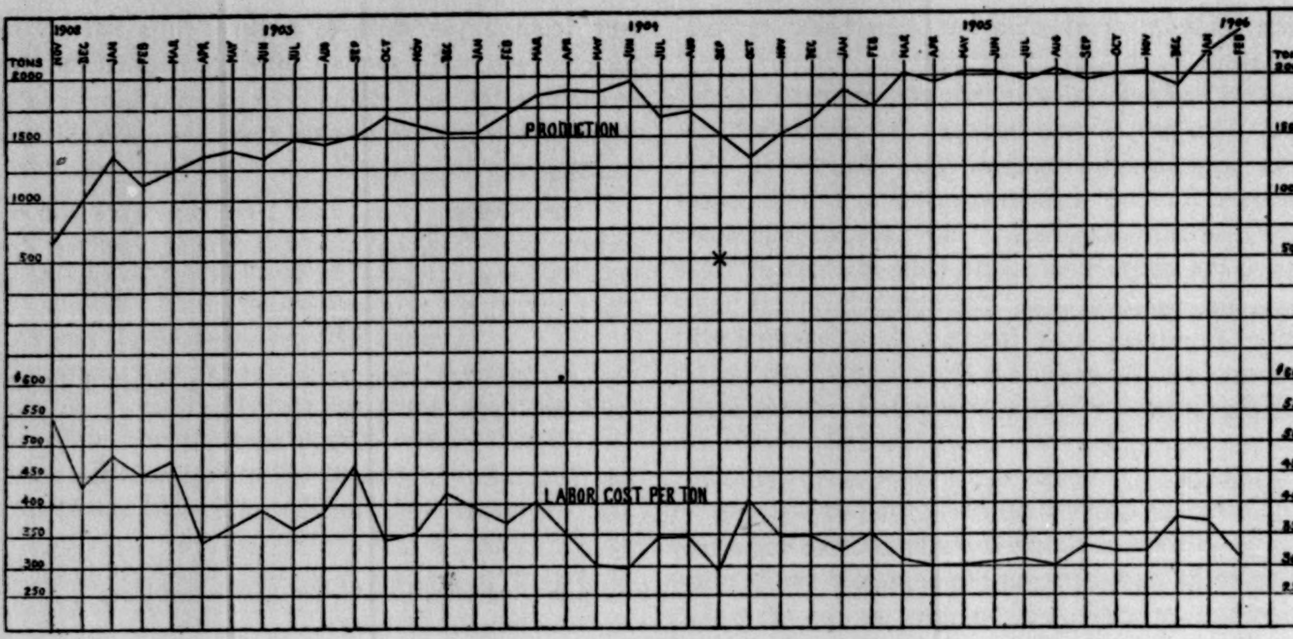


CHART A

TABLE I

DATA ON CHANGE FROM TWO TO THREE SHIFTS
MILL No. 2

	No. Men Employed on Two Shifts	No. Men Employed on Three Shifts	Increase in No. of Men
Acid Plant	8	15	7
Digester House	18	27	9
Boiler House	24	37	13
Engineers	7	10	3
Wood Room	78	114	36
Wood Yard	19	23	4
Log Pond	20	30	10
Blowpits	10	15	5
West Screen Room	8	9	1
East Screen Room	10	12	2
Machine Room	113	135	22
Bleachery	2	3	1
Filter House	2	3	1
Press Repairs	2	3	1
Cell House	15	19	4
TOTALS (Tour Workers only)	336	455	119
Day Workers	200	200	
GRAND TOTALS	536	655	119

% Increase (Considering Tour Workers Only) 35.4%

% Increase (Tour and Day Workers) 22.2%

percentage of increase in the tour workers only was 35.4 per cent and, considering all workers in the plant, was 22.2 per cent. In this mill, as in the previous one referred to, the actual amount of money paid per day of eight hours was the same as was previously paid for twelve hours. In this latter mill, while the labor cost per ton increased at first about 22 per cent, this was soon offset by the increased production. Our experience indicates very clearly that the large production increase comes because of the fact that our men are wider awake and more "on the job" and, consequently, have much better control of the processes.

We actually increased the production of this mill from 42,000 tons to 111,000 tons per year, in seven years' time, without adding to the equipment a single digester for cooking the pulp; in other words, the production was increased 2.9 times. I am not claiming that this increase in production was due entirely to the change from two to three shifts, but I do know that we would not have been able to reach anywhere near this figure if we had continued to operate on the two-shift basis. Furthermore our quality changed during this period from the poorest pulp manufactured to the very best. Our keenest competition had always been from Europe, largely because of the fact that European quality was very much better than our own.

Our men, however, were not constantly tired out, but mentally alert, because of the reasonable hours that they worked, so that we were able to eliminate European competition entirely and our pulp invariably obtained the preference because it was cleaner, stronger and better in color. In Europe, at that time, the mills were all on a two-shift basis.

Right at this point, it might be well to mention the fact that we doubled the number of our employees while the production was being trebled, but this increase was largely because of the fact that in the development of the new processes, which made for greater economy in the use of materials, we needed a larger working force. The net result, however, was a reduction in the actual cost of manufacturing the pulp (in spite of the increase in the cost of raw materials) of from $5.00 to $6.00 per ton, with the equivalent of an additional reduction due to the value of our by-products of approximately $2.00 per ton.

Table II gives the actual figures from a small plant which changed from the two-shift to the three-shift basis, but because of the fact that the plant itself was modern and up to date, an actual saving in the number of men could be effected, so that the total increase in the number of men was only 22.1 per cent., considering tour workers only; and the actual increase in cost 13.1 per cent. The rates of pay per day, as shown, and the drop in wages which took place here were due largely to the fact that this mill had postponed changing from two to three shifts so long that they were obliged to raise the hourly rates of their men so that they were half way between the normal paid by the industry, on a three-shift basis, and their old original rates paid on the two-shift basis. After the change was made these rates became practically normal for that section of the country where the three-shift wages were in effect.

The per cent increase in the number of men, when day workers are also included, was only 12.1 per cent. In this case, as in the previous one, the tonnage of the mill increased. It rose in a few months from an average of 70 tons per day, on the two-shift basis, to an average of 100 tons per day on a three-shift basis.

To a considerable extent this increase in production came from mechanical improvements made in the processes, but from actual observation of what took place I know that great impetus was given to the betterment of the quantity and quality of output by the change to shorter hours.

The man who managed this plant during the time that this change took place wrote me, when he sent me these figures, as follows:

> "You, of course, are familiar with the difference in spirit that permeated our organization after we changed to three shifts. The men were wide-awake, energetic and on their toes, and interested in their work, while on the old basis they lacked enthusiasm and had a tendency to neglect things and sleep on the job. Much of the increased production, in my judgment, came from the change to the three-shift basis."

TABLE II

DATA ON CHANGE FROM TWO TO THREE SHIFTS
MILL No. 3

Two Shift				Three Shift		
No. Men	Total Cost per Day	Ave. Pay	Dept.	No. Men.	Total Cost per Day	Ave. Pay
6	$23.68	$3.95	Acid Plant	5	$20.34	$4.07
6	27.36	4.56	Digester House	9	37.44	4.16
22	87.89	4.00	Screens	29	97.66	3.37
12	57.72	4.81	Bleachery	12	56.58	4.72
40	165.60	4.14	Machines	51	197.76	3.88
18	70.40	3.91	Boiler House	21	79.50	3.79
104	432.65	4.15	Total Tour Workers	127	489.28	3.85
80			Day Workers	80		
184			Total Men	207		

% Increase in No. of Men 22.1, considering tour workers only
% Increase in Cost 13.1, considering tour workers only
% Increase in No. of Men when day workers are included 12.5

Interpretation of Experiences

This interpretation has, to some extent, been given in explanation of the actual illustrations. Three generalizations, however, can be made from these experiences, which I will summarize as follows.

1. That there is a limit to the physical endurance of men and that there is a time beyond which nothing further is gained by prolonging the hours. Our experience has been that, so far as the paper industry is concerned, eight hours constitutes a proper day's work, that even in the case of our day workers more work was actually accomplished in eight hours than in nine or ten-hour day.

2. It is equally true that men are not mentally alert when physically fatigued. Mental alertness is absolutely essential to good quality of product and our experience has been that invariably when the obstacles to uniform quality are removed the obstructions to increased output are also removed.

3. As maximum quantity and quality cannot be obtained when the workmen are tired out, so is it impossible to operate economically unless the hours are short enough to permit a proper amount of relaxation

outside of the plant. It is so obviously true that good quantity and good quality make for economy of operation that it seems hardly necessary to make this final generalization. I am making it merely because we demonstrated to be a fact that it is more economical to operate a plant on a three shift basis than on two.

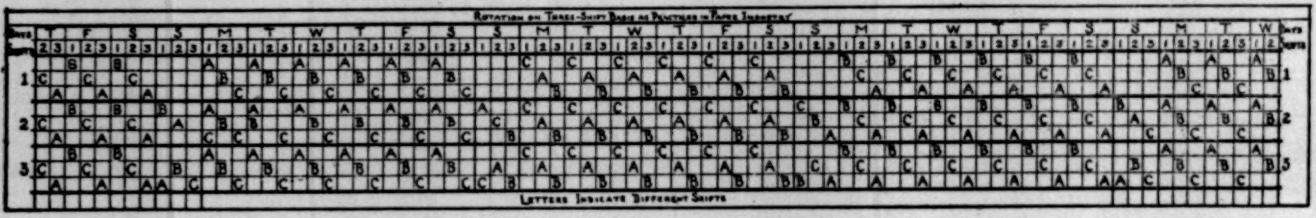
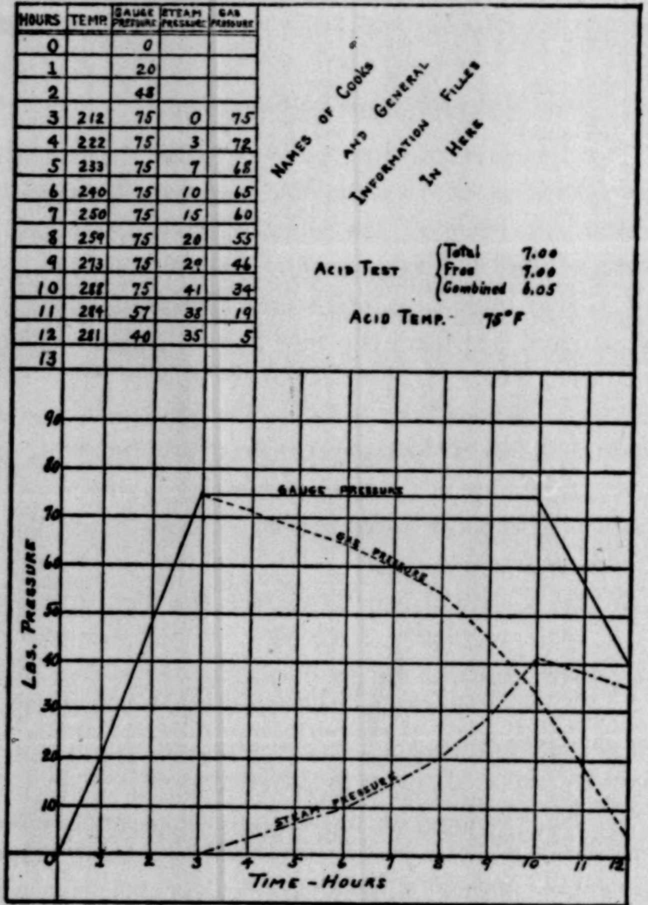

Rotation on Three-Shift Basis as Practised in Paper Industry
Days
Shifts
T F S S M T W T F S S M T W T F S S M T W
1
2
3
Letters Indicate Different Shifts

CHART B

Rotation of Shifts

Chart B shows three methods of rotating shifts, as it is ordinarily done in the paper industry. The letters indicate different crews, or shifts, and a complete period of rotation is shown. No. 1 indicates the method where there is no Sunday work. No. 2 indicates one way of changing the rotation in a seven day continuous process department, such as the boiler house, digester building, etc.; and No. 3 indicates an alternate way of changing shifts, which is frequently used.



HOURS	TEMP.	GAUGE PRESSURE	STEAM PRESSURE	GAS PRESSURE
0		0		
1		20		
2		48		
3	212	75	0	75
4	222	75	3	72
5	233	75	7	68
6	240	75	10	65
7	250	75	15	60
8	259	75	20	55
9	273	75	29	46
10	288	75	41	34
11	284	57	38	19
12	281	40	35	5
13				

Names of Cooks and General Information Filled In Here

Acid Test { Total 7.00
Free 7.00
Combined 6.05

Acid Temp. 75°F

CHART C

It will be noted from this that the men are all on different shifts each week. This happens to be customary in the paper industry. The men, however, could remain two, three or four weeks on each shift, in fact there are one or two mills where the men remain two weeks on one shift before changing. I know of no instance, however, in the paper industry, where men remain constantly on the same shift. In the continuous process department where seven days a week are necessary, we make it a policy to encourage the men to lay off one day in seven.

A plan of operation in the maintenance department in a plant where we had approximately 300 men at work on construction and repairs, may be of interest. The maintenance and repair work in all paper mills is a big factor on Sunday, when the plant is down, especially in a mill that is being rebuilt, so it is necessary for a full crew to be on hand on Sundays. However, we found our men tiring out under the strain and devised a plan for practically raising the "time and one half" Sunday's pay to double time, only the extra time accumulated as a credit which the man could take off during the week at the company's expense. In other words, if a man worked all day Sunday he could take off half a day during the week, or he could allow his time to accumulate and take off a full day every two weeks.

Management Changes Required

One of the difficulties that will be encountered in any process that requires close attention is the greater variations which tend to develop when a larger number of men are at work. We had heard that the quality would vary more on three shifts than on two. However, we found that there was very little to this contention, as the greater alertness of the men, because of the shorter hours, offset the variations due to the increase in the number of persons controlling the operations. However, simultaneously with the change to the three-shift basis we began keeping continuous records of performances, which enabled the workman to more readily visualize what had taken place before he came on. In this way he could more consciously carry on the process and so produce the least possible amount of variation in the product. What I mean by this is shown in Chart C, showing a cooking chart from our digesters. The heavy line is drawn to indicate the change of shifts. Obviously a cook coming on at the seventh hour would easily be able to control the process, knowing just what had taken place previously. A graphical visualization of this work is very important. This illustration is taken from a sulphite pulp mill and the following is a description of this operation, taken from a paper called "Non-Financial Incentives," which I read before the American Society of Mechanical Engineers, December, 1918:

> This chart was designed to give the cook information about the reactions in the digesters in which the wood chips are cooked in a 6% solution of sulphurous acid partly combined with a lime base.
>
> The digesters have a conical top and bottom and are usually 50 ft. high by 15 ft. in diameter. After the acid and chips are put into the digester and the cover is put on, steam is turned in at the bottom and the pressure brought up to 75 lbs. per sq. in. above atmospheric pressure.
>
> As this does not heat the digester sufficiently to produce disintegration of the wood, it is necessary to relieve gas through a relief valve on the cover. Because of the removal of this gas, which is afterwards reclaimed, more steam can come in at the bottom and thus the temperatures are advanced. The skill in cooking consists in the proper control of the relief valve.
>
> Before the introduction of these cooking charts illustrated by Chart C, all this was left to the unaided judgment of the cook, with usually nothing to help him but a small hand thermometer and a pressure gauge. Of course, great variation in the pulps was the result. The cooking charts, plotted by the cooks themselves, however, helped greatly as they enabled the quick visualization of the work. On these charts, temperatures are converted to pressures for the reason that the pressure in the digester comes from two sources, one the natural pressure due to steam, and the other due to the sulphurous acid gas. The pressure, for instance, which would correspond to a temperature of 212° would be 0 at atmospheric, yet from the chart you will see the gauge pressure actually showed 75 lbs. The difference between 0 and 75, therefore, is caused by the presence of sulphurous acid gas. As the cooking progresses, the gas is naturally used up; first, by being relieved for the purpose of making room for more steam; second, by the natural combination of the acid with the organic compounds liberated during the cooking process.
>
> At the end of the cooking process the gauge and steam pressures will naturally come very close together as the greater part of the SO_2 gas has been used. The gas pressure curve is obtained by subtracting the steam pressure from the gauge pressure. It is really a resultant of the other two. If it drops too rapidly the cook knows that he is relieving his digester too hard and checks the opening of the relief valve. If it does not drop rapidly enough he knows he must open the valve wider in order to increase the relief. Of course, the figures are taken from recording instruments which are checked daily to insure accuracy. Naturally, an ideal cooking chart was soon formed, being the joint work of the cooks handling the digesters and of the chemical research department.
>
> Immediately after the introduction of these charts a very marked increase in the uniformity of the pulp was noticed, and the cooks, while at first opposed to the new method of "cooking with a lead pencil" as they called it, soon learned to like their work, much better for the reason that they now had some way of visualizing the work in its entirety. In addition to more uniform quality of the pulp, the yield from a cord of wood increased something over five per cent.
>
> We soon found that it was necessary to give some sort of continuous progress record if we were to keep up the interest in the work, because no man could carry in his mind anything but a general impression of his progress from day to day. Several good records for one day are only like so many good golf drives. They are a source of satisfaction at the time, but just as the score in golf denotes our real mastery of the game, so does the progress record measure the man's increasing mastery of his work, and we feel that it is one of the moral obligations of the management to keep such records for the individual workman. Without these records men will not think of improvements in the process and they cannot be blamed for becoming indifferent. How long, for instance, would a superintendent or manager retain his interest in the economical operation of his plant if his cost sheets were withheld? We, as executives, must have quantity, quality and economy records, otherwise our interest soon lags. Why, then, should we expect the workman to be interested when he is not furnished with a record which at least reflects one of these elements?
>
> Referring to Table III, it will be noted that there are nine men cooking. These men are posted in the order of seniority, with the highest monthly record on top. There are three foremen at the top of the record. Each of these foremen has three cooks under him and their standing is made up by taking the average records of the men under them. In this way we are enabled to get not only the individual records of the men, but the group, or team-work records, as well. The lower group is merely for the convenience of the department head in charge and gives the relative standing of the large, medium, and small digesters. This is irrespective of the men who are working on them.
>
> The total progress record figures in the first column are made up of the temperature, color, time and blowing records. The relative values that these have in the total record are shown at the top of each column, the total adding up to 100. The small variation in the monthly average column is characteristic of all our progress records, and shows how great is the incentive when individual effort is intelligently recorded.
>
> The temperature record is obtained by taking half-hourly readings from the recording-thermometer chart, upon which a standard temperature curve has been plotted, calling each reading which happens to fall on the standard line 100, and a reading 20 deg. either side of the standard line 0. This means that for each degree off of the standard, 5 points are deducted from the progress record.
>
> The color record indicates how near the men come to blowing the digester when the color of the liquor shows the proper amount of lignine in the solution. The sample, drawn from the side of the digester, is compared with the standard color. To get a methematical value for this factor a range of colors from a dark to a very light was obtained, the particular shade which was taken as standard marked 100 and one shade either side 10 points less than 100.
>
> The time record is obtained by calling a certain time of cooking 100 and taking off on each digester cooked one point for each minute above or below this standard.
>
> The blowing record is obtained by calling 30 lb. pressure 100 (most of the cooking being done at a pressure of 75 lb. per sq. in.) and 60 lb. 0, the idea being to get the pressure as low as possible before blowing the digester.
>
> It will be noted that the temperature value is higher than any of the others. This is because it is the most important element. The color record coming next in importance is given the next highest value, etc.

Table III. RECORDS OF INDIVIDUAL COOKS

Date, June 2, 1916.

Name	Total Progress Record		Relative Value 50		Relative Value 35		Relative Value 10		Relative Value 5		General Information					
			Temperature Record		Color Record		Time Record		Blowing Record		Average Maximum Temp.		Average Test 5th Hour 1.25		Average Test 6th Hour 0.80	
	Daily Avg.	Mo. Avg.	Daily Avg.	Mo. Avg.	Daily Avg.	Mo. Daily	Daily Avg.	Mo. Avg.	Daily Avg.	Mo. Avg.	Daily Avg.	Mo. Daily	Daily Avg.	Mo. Avg.	Daily Avg.	Mo. Avg.
Myler	88.2	88.3	84.8	85.9	99.3	98.3	90.6	88.6	58.8	59.5	293.6	294.7	139	134	100	103
Duggan	86.2	87.7	81.8	85.1	96.4	97.7	95.3	91.9	59.2	60.8	299.0	298.5	134	133	96	95
S. T. Ellis	85.8	87.1	79.1	83.2	98.8	97.7	95.1	93.8	57.9	59.7	299.8	299.6	125	129	101	102
Rodgerson	86.7	89.3	83.3	88.2	99.2	99.0	92.5	88.8	64.3	62.1	296.2	294.7	161	134	105	103
J. P. Ellis	89.5	88.7	87.2	86.8	96.7	97.7	96.7	94.8	56.3	62.0	294.7	297.2	123	129	94	96
McKee	88.8	88.3	84.8	86.0	100.0	98.9	90.5	90.0	56.4	59.9	294.4	294.7	132	133	96	101
Teeling	88.0	88.2	84.2	85.9	100.0	98.5	92.8	90.7	62.0	61.0	299.5	298.3	128	135	91	104
McKelvy	83.1	87.1	77.1	84.4	96.0	97.8	93.3	89.0	62.0	60.5	204.3	298.8	122	129	96	97
Element	84.9	87.2	79.1	83.8	96.7	97.7	95.2	92.2	59.3	59.9	297.8	299.7	130	131	98	95
McLean	83.9	87.2	75.3	81.9	98.8	99.1	97.8	93.3	59.2	57.8	306.4	302.1	137	134	109	102
Johnson	85.4	86.4	77.9	82.2	97.5	96.1	94.4	97.0	52.3	60.2	294.5	296.3	136	131	102	101
Neil	89.2	86.1	89.2	86.1	86.3	83.7	98.8	96.8	54.6	56.3	289.3	294.4	130	133	100	105
Large	86.6	87.4	82.0	85.5	98.5	98.3	91.9	87.0	59.8	59.9	299.0	296.4	129	133	95	100
Medium	87.2	87.9	83.3	85.7	98.5	97.7	94.9	91.8	58.6	61.6	298.2	296.9	134	132	99	99
Small	85.9	86.5	80.1	83.1	98.2	97.9	94.9	88.3	57.6	58.3	298.4	299.3	131	133	102	100

By an arrangement of this sort, by simply changing the relative value of the different factors, it is possible to emphasize any particular phase of the work. The men willingly pay the greatest attention to the factor that has the greatest value because it gives them the better record and because they know the reason for the change. For instance, if it is desired to emphasize quantity, we give a larger value to the time record and a lesser value to the temperature record. Production is then somewhat increased at the expense of quality.

While I could give many illustrations similar to the one just given of our cooking operations, I will give only one final illustration of how economy progress records meet with equally great response. In the plant where this system was developed were employed over 1,200 men and perhaps half of these men had individual progress records and the rest came under some sort of group-progress record. Invariably the records proved themselves to be an incentive to greater productivity.

I could give many more illustrations of a similar nature, but this one is sufficient to illustrate the principle involved, namely, that it is a very simple matter to keep sufficient control records, which will much more than offset any variation in quality that might come from increasing the number of men. In fact, I do not hesitate to say that it has been demonstrated beyond any question of doubt that much greater uniformity is being obtained where the mills are working on a three-shift basis than where they are working on a two-shift basis.

Further Plans Contemplated

The paper manufacturers' experience with three shifts has convinced them that it is unquestionably a much more economical operation, from every point of view, than the two-shift method. They have learned that tired men do not make good workmen. It logically follows that wherever men are working seven days each week a way must be provided so that they have one day off. It is being proposed now to have an extra crew of men constantly at work to take the places of the regular-shift men, so that a systematic relief is provided. The method of doing this, however, depends upon the number of men and also upon certain local conditions. It is obvious that once employers work with their employees in bringing about an acceptable method this result can be easily accomplished. The employer, as a matter of fact, has everything to gain by making such an arrangement, for it is an extremely short-sighted policy to work tired men. When the plan of accumulating the half time of the men who work on Sundays on the day crew was first put into effect, we recognized that it was only the first step in arranging for full time off one day each week. We also recognized that the one day off in seven, in a continuous operation, was another logical step which should soon follow.

Suggestions for Other Industries Than the Pulp and Paper Industry

I would like to state at this point that my willing acceptance to talk to you on this subject is because of the fact that I realize what I say will be helpful to other continuous-process industries in solving this problem of changing from two to three shifts. Therefore, a recitation of the difficulties which we encountered will be perhaps as helpful as pointing out the advantages.

First, we had heard that men would not want the three shifts, but preferred the long hours. The results, however, proved that our men almost invariably welcomed the change to three shifts. There were a few men, such as foremen who prophesied difficulties, and there was occasionally some old man who had worked two shifts all of his life and gotten so in the habit of it that he preferred not to change; but I can say unqualifiedly that the change was enthusiastically welcomed by at least 99 per cent of our men, and the remaining one per cent were quickly convinced.

I have known, for instance, where the management has compromised with the men to such an extent that they were getting practically three-shift rates and still working two shifts, where the workmen objected to the cut in wages which must come. However, it seems to me inexcusable that the management should operate its plant in such a short-sighted way, *i.e.*, paying three-shift rates without getting the benefits that come from the shorter hours, which keep their men mentally and physically alert at all times.

Second, we argued ourselves into believing that the men would not know what to do with their time when off duty. We soon found, however, that by assisting in the creation of outside recreational facilities that this was not a problem at all; in fact, it became a big asset to us in developing *esprit de corps* in the community as well as in the plant. I do not mean that we adopted what is familiarly known as welfare work. I do not believe in this because of its paternalistic nature. However, when the men are encouraged to make their wants known and the company recognizes its responsibilities to the community as well as to its employees, it will not be long before the men will be actually creating the necessary means of recreation.

Third. We thought, at first, before we analyzed the situation carefully, that it would add fifty per cent to our labor costs. The figures given previously, however, indicate that this was by no means the case. As a matter of fact the labor cost per ton of product invariably decreased.

Fourth. The problem of shortage of labor was one which we felt to be quite serious, but this was easily overcome by distributing our key men throughout the plant and, while there was a slight amount of confusion to start with, this was soon over.

The advantages given to promote employees to better positions are obvious and the better spirit which soon develops quickly offsets the small temporary losses occasioned by the change. I cannot help making the observation right here that with the present curtailment in industry all over the country, the time is ideal for putting all two-shift industries on a three-shift basis.

Fifth. Greater demand for housing facilities was an objection which seemed, at first sight, to be a very serious one, especially in one particular instance where the plant was located in a small community. This, however, did not prove to be serious, as the actual percentage increase in the number of men was really small and the temporary congestion was quickly relieved.

In this connection, it should always be borne in mind that the change from two shifts to three shifts never means an increase of fifty per cent in labor, but always a very much smaller percentage, owing to the fact that the number of men in each operation can be reduced because of the shorter hours and also from the fact that in all industries a large percentage of the men are on day work.

Sixth. I have heard the argument put up in the paper industry, when the three-shift movement first gained headway, that it would make it impossible for us to compete with foreign mills. This argument really no longer holds, because most foreign mills are on a three-shift basis at the present time, and I am informed that the English Steel industry is entirely on three shifts.

General Conclusions

It seems to me that the most obvious reason for the three-shift basis is that the day naturally divides itself into three equal parts. The principle is as old as the hills and has been enunciated from time to time by the world's greatest thinkers. Eight hours of actual application to the performance of the daily work, by which we earn our living, is generally sufficient. By actual work, I mean the close application of men to their daily tasks. It makes very little difference whether this is operating a bolt cutting machine, digging a ditch, or attending to the direction of a corporation's affairs from a desk. I know that some men boast that they work sixteen hours a day and then wish the day were longer. If these men would stop to analyze their work, however, they would find that an average of eight, out of the sixteen hours, is devoted to a different *kind* of work. It consists largely of coming into contact with new individuals and with different lines of thought. In other words, this second period of the day is devoted to mental activities of a more or less recreational nature,—not to close application to work for the execution of which they are directly responsible. Finally, a third period of eight hours rest,—it may not be actual sleep, but complete relaxation,—is necessary, otherwise man would so deplete his vitality that he would wear out before his time.

The logical division of the day, it seems to me, is eight hours of work, eight hours of recreation and eight hours of sleep. In any case, my experience of twenty-two or twenty-three years in a continuous-process industry has demonstrated to me that this grouping produces the best results from the standpoint of increased production, better quality and decreased cost.

Finally, let me state that the result of our experience in humanizing work in the pulp and paper industry has been to make us realize that after all industry is for service rather than for profit. We were obliged to render a greater service to our customers, by making a better product; to obtain the better product we had to serve our men, by thinking of their human needs and cease classing them with our raw materials.

The human need is to release the creative power which resides in man's faculty; first, to observe the operation of natural law; second, reflect upon the observed operation until he has thought out the principle involved; third, plan the ways to use this knowledge to obtain better results than before; and, fourth, create the necessary conditions to make this possible.

It is the deadly monotony of repetitive work that is the curse of modern industry and unless this is changed (as we are successfully changing it in the pulp and paper industry) we can look forward to continued agitation for shorter and shorter hours. Even eight hours will not satisfy.

One of the great troubles with the business man today is that he is confusing cause and effect. It is because we are thinking only in terms of profits, which are the *effect* of service, that we are automatically cutting off the service, which is the *cause* of the profit. The service, however, must not only be to the customer, but also to the employee. An industry which renders service to society is bound to be rewarded by society and, therefore, cannot help being a profitable business.

A tremendous responsibility rests upon the Engineer because he is perhaps more conscious of the operation of the law of cause and effect than any other of our professional men.

Many of our big industries are today managed by members of the engineering profession, so it augurs well for the future when the constitution of the Federated American Engineering Societies begins with the following preamble:

> Engineering is the science of controlling the forces and of utilizing the materials of nature for the benefit of man, and the art of organizing and of directing human activities in connection therewith.
>
> As service to others is the expression of the highest motive to which men respond and as duty to contribute to the public welfare demands the best efforts men can put forth, NOW, THEREFORE, the engineering and allied technical societies of the United States of America, through the formation of The Federated Engineering Societies, realize a long cherished ideal,—a comprehensive organization dedicated to the service of the community, state and nation.

3. By C. L. Patterson[1]

The Association which I have the honor to represent is an association of manufacturers of sheet steel and tin plate, and these plants are largely on an eight hour basis, but few, if any of the employees, working more than ten hours per day at the most. But many of these plants also have steel plants, open hearth and blast furnaces, in connection with them; and some of them at least, are still working twelve hours a day and seven days a week, and it is with these plants in mind that I venture to discuss Mr. Drury's able presentation of this subject.

I have listened with interest to this address and what has perhaps impressed me most has been the absence of unfairness, misrepresentation and ignorance of the problems of the steel manufacturing industry which usually characterizes discussions of this subject. I failed to hear it even inferred that the twelve-hour day and the seven-day week in the steel mills was due to the capitalistic system or the greed of the employers which is the stock basis for criticisms of the long day in the steel mills. I wonder if it has ever occurred to thinking men and women who have interested themselves in promoting better working conditions in the steel mills that the seeming antagonism on the part of the manufacturers of steel to the substitution of the three-shift system for the twelve-hour day has been due to the manner in which they have been approached on this subject by well-meaning but impractical and uninformed theorists who seem to be under the impression that the only question involved in changing from the two to the three-shift system is a question of dollars and cents and that the manufacturing industry is one in which profits should have no consideration.

I know that the substitution of the eight-hour day for the long day is receiving the serious consideration of the leading men in the industry today; that they will welcome suggestions and a thorough and detailed discussion of the problems such as we have listened to this evening; and in my opinion, the day is very near when the twelve-hour day in at least the larger plants will be a thing of the past.

Mr. Drury has given us the most illuminating and thorough analysis of this subject that I have ever heard or read, and I have every reason to believe that his effort will meet with not only earnest consideration but approval on the part of manufacturers of steel and it is my intention to place a copy of this address in the hands of every member of our association.

I can think of but one phase of this subject which might have been discussed at greater length, and that is perhaps superfluous before an audience such as we have here this evening. I think the seven-day week is perhaps productive of greater dissatisfaction among the employees, greater bodily fatigue, and greater interference with the development of American home life, than is the long working day, and this emphasizes the necessity of a further explanation of what we mean by a "continuous operation." I am not familiar with any industry where continuous operation is more economically necessary than in the steel industry. To reduce solid ore to liquid iron in the blast furnaces and solid iron to molten steel in the open hearths, is a process requiring hours of time and a high degree of heat, and the process, once started, must be continued to the end. It is impossible to temporarily interfere with the process without destroying the composition in a blast furnace and to close down the open hearth furnaces for twenty-four hours would so greatly reduce the output, even after the furnaces were recharged and reheated, that the seven-day week, that is, seven days operation, is vitally necessary to the success of the industry. I am advised that a two-day shut-down of the blast furnaces of one of the large steel corporations during the May Day riots in 1915, cost that corporation a quarter of a million dollars to remove the ruined contents and repair the damage done. Since we cannot or have not found a process for making steel which will supersede the present continuous process, we must find some method by which the men who make steel can earn a wage proportionate to their skill and the hazard of their calling, and at the same time live normal American lives.

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[1] Secretary, Bureau of Labor, National Association of Steel and Tin Plate Manufacturers.

I am not prepared to say that the eight-hour day is the maximum which the demands of production require. I am not satisfied that the nine or the ten hour day is too long, and I know of no real reason why the shifts should be confined within a period of twenty-four hours or why men could not work three shifts of ten hours each, providing due consideration be given to the physical well-being of the men and the labor costs of manufacturing steel, but I do believe that the twelve-hour day and the seven-day week in the steel industry must and will be abolished and that the coming months, for the first time since 1914, is the opportune time for making this change.

We have heard much in recent years of the growing importance of the foreman in industry, and I am one of those who believe that the foreman is the key man in any plant and that he, more than any other individual in the plant, is responsible for harmonious industrial relations. Permit me, in conclusion, to quote the statement of a foreman in a steel plant, who in reply to an inquiry as to what he regarded as one of the greatest obstacles to a foreman's success, said:

> The greatest thing that I am up against is the fact that I have no time to study and keep up with the procession. My work, with its hours of overtime, gives me very little time to think and plan for the future. When I go home at night I am so tired that I cannot keep awake when I pick up a magazine or a book. I am too tired to go down town to a lecture. If I do go down, I have to dress up, shave, walk to the car, and then I don't get home until late, and as a result, I do not get near enough sleep. The next day I am dopey on the job. I once started a course of study in a correspondence school. I couldn't keep it up as I had to work overtime so much. Since that discouragement I have always been reluctant to start any more studying, but I want to do it.

That foreman, ladies and gentleman, has stated better than I am able, why the long day in the steel industry must go.

4. By William H. Baldwin[1]

Having for a long time believed that the 12-hour day ought to be abolished, I willingly accepted an invitation to participate in the discussion of the subject this evening. Mr. Drury's carefully prepared report shows a gratifying progress on the part of the manufacturers in the steel industry towards making the change to the three-shift day, and it also reveals some obstacles in the way of this.

I am glad that the subject is being taken up in this careful manner, because I believe the change has been retarded rather than helped by the ill-considered censure of some well-meaning persons, who have confused it with other matters which are by no means so clear, and which, if carried out as they suggest, might in some respects be harmful to the men as well as to the companies.

In organizing the Ohio Steel plant, which I helped build twenty-five years ago, it was necessary for us to have the 12-hour day, as our competitors did, or our company, which depended upon floating loans for all its working capital and part of the cost of the plant, would have gone to the wall. I have no sense of blame for what was then required of the men, because I worked with them and constantly exceeded the 12-hour limit in order to keep the business going, and I have a feeling of thankfulness to the loyal men in all positions in the plant who worked with us to build up a successful business. We protected them from accidents to the best of our ability, but we had neither the money nor the strength to do for them what has been done so well by so many steel companies since. The eight-hour day would have been out of the question, but as the output increased, we voluntarily put some of the men in the most difficult positions on eight hours because it increased the production to do so.

The principal objection to the 12-hour day, in my opinion, is that it takes so much of a man's life that he cannot get his share of the benefits and privileges which belong to American citizenship; and nothing but the necessity of self-preservation, under such circumstances as I have spoken of, justifies a company in continuing it. It is true that great numbers of men have been and are, as Mr. Drury has shown, willing to work 12 hours a day, and some prefer to. It is possible for them to lead upright, honest lives while doing so, and in many positions the work is not too hard physically; but the tendency is all towards shorter hours, as it should be by any fair distribution of the advantage of the increased facilities for production, and the men who are willing to work 12 hours must necessarily diminish relatively in number and in general standing as workmen.

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[1] Formerly Secretary Ohio Steel Company.

No one would now think of requiring a man to work 12 hours a day were it not for the necessity of continuous operation during twenty-four hours; but the men are not responsible for this necessity, and they ought not to be required to give up so large a part of their lives for the benefit of employers and stockholders. On the whole, Mr. Drury's statement seems to show that a change to the three-shift system, as I have always assumed, must add more or less to the cost of the product. This increase may be reduced by careful management, but most of all by the effect which the change has, or ought to have, on the spirit of the men. This is an element of the very greatest importance in any steel plant, and nothing did more to save the plant, of which I have above spoken, from failure than such a spirit of loyalty on the part of the men.

It may have been a reciprocal appreciation of what they did for the company which made me later feel strongly that perhaps the most important thing in the steel industry at that time, certainly more important than the discussion of over-capitalization, as to which intelligent men were able to protect themselves, was the abolition of the 12-hour day; for I discovered, in connection with the government investigation of the steel industry some years ago, that the profits of the steel manufacturers of the country, over a period of five years, were ample to absorb whatever increase in cost there might be in doing away with the 12-hour day, and still pay fair returns to the stockholders.

This beautiful building in which we meet to-night is the gift of a man of great ability, who made the most noble benefactions of libraries, art galleries, and scientific institutions, which the world has ever known. All these are for the enrichment of the lives of mankind, and we honor him for them; but in thinking of them, I have been unable to avoid a feeling of sadness when I ask myself of what possible benefit any art galleries or libraries can be to men who must work twelve hours every day, as thousands of men have been obliged to do in the plants in which was made the fortune from which these libraries came.

I am aware that it is a mistake to idealize these men, just as it was a mistake in our recent policy towards Mexico to assume that, if granted the same freedom, the Mexicans would conduct themselves as American citizens do. Many of these men would not go to the libraries, or use their time to the best advantage if relieved of four hours work per day; and in my opinion many of them, while working twelve hours, were and are doing more good for themselves and for the country than they would be in following a revolutionist like Foster towards the control by the ignorant, as they did in the recent steel strike; but these men are in reality working for all of us, and it is the duty of those who get the benefit of their labor to help towards seeing that they have a fair chance to obtain the knowledge and conceive the ideals of decent American citizens.

The establishment of prohibition throughout the country, perhaps the greatest reform the world has ever known, has not only done away with the temptation to these men to waste their time and wages in drinking, but it has also diminished the danger of violence in any differences between them and their employers, and made it easier to encourage them to make the most of their lives. Because of the vast benefit of prohibition to the steel manufacturers, far exceeding in my judgment any possible loss in doing away with the 12-hour day, they might all well afford to make the change, and devote besides some money towards providing instruction and help for the improvement of the time which the men would thus gain.

I have spoken of the spirit of the men. Tasks and compensation must necessarily differ, and that some are hard is not inconsistent with satisfaction in one's work; but I do not see how it is possible for a man, who is working for a company which makes so much money as the steel companies have made in the past, to have a really cordial feeling toward an employer who obliges him to give up twelve hours of his day while the employer enjoys both leisure and luxury from his profits. I believe that because of the force of habit, and the relative ignorance of the men, the present system may be maintained for some time yet; but there is a new spirit awake in the world. The changes to the three-shift system in several countries in Europe have been made since the war, and no doubt because of this new spirit. The ideas which prevail among the metal workers in Italy, alluring but unmistakably destructive as they are, have made little progress in this country. There is perhaps no real danger that they will spread here; but the demand of the coal miners a year ago, that their working day be limited to six hours, perhaps the most unwarranted hold-up ever attempted with the American people, shows that even here great numbers of men are capable of making a forcible demand for a four-shift day. I believe that nothing would do more to forestall such unreasonable demands of any kind, and to establish more cordial relations between the companies and their men in the steel industry here, than for the managers to promptly take up with the workmen the change to the three-shift system for all men now working twelve hours. It would, I believe, promote loyalty, increase the feeling of common interest, shut out interference by outsiders, and in the end be a blessing to all concerned.

It is true that this change, which has long been talked of and which was perhaps necessarily delayed by war conditions, will require more men, and in some cases more houses; but the steel companies can overcome these obstacles as they have overcome so many others, and with the complete abolition of the seven day week and the 12-hour day can appeal confidently to their men to join in securing that maximum production of which the world is in so much need.

5. By Whiting Williams[1]

I want first of all to give confirmation to the remarks made by Mr. Drury as to the English situation. This summer it was a very great surprise to find that the entire British iron and steel industry had gone over to the eight-hour day and gone over so hard that there was practically no further discussion. Everybody appeared to feel that the eight-hour day had absolutely won its way ever since it had been made universal by the law of March, 1919. I confess, also, that I found myself rather in an embarassing situation when, as a manifest steel worker from America, I tried to tell my English friends about the situation here, and found them all assuming that of course long ago in the "land of opportunity" we had given up the twelve-hour day.

To my, "No, we have twelve hours every day and often a seven-day week," they would snort a "Well, Hail Britannia, I supposed we was bloody well the lawst"!

I found also they had put into operation in getting the eight-hour day the use of a sliding scale by which the expense of the change was partly borne by the workers and partly by the management according to the workers' earnings. This was feasible because practically all of the tonnage workers in the steel trade in Great Britain have been working for a long time on a sliding wage scale by which when the price of steel is high they get a higher rate of pay.

I think it is very largely as the result of this that conditions in the steel and iron industry in Great Britain are believed by a great many people to be better than in any other field of industrial relations in Great Britain.

Following my experience in the labor gangs of steel plants in this country in 1919, I came to feel that the twelve-hour day was very distinctly the cause of what I have heard some steel executives speak of as the "lessening quality of the personnel in steel." Good men that go into the steel industry are pretty likely to find it an unattractive place because of the twelve-hour turn. Too generally steel is accepted as a man-killer; too generally those who have come up through the process successfully feel that there is no other way of making steel than that it should always be a man-killer.

I am quite sure, however, that the steel makers are paying a very great price for the long turn in terms of a lowered quality of their personnel. I know I got a great shock that first night in the steel plant when I joined my companions from all over the world and tried to show that in spite of my soft-handedness I could do as good a night's work as they. I started out to move those bricks—those hot bricks and cold bricks and medium bricks and broken bricks and good bricks—tried to lift bricks and kick bricks and throw bricks for twelve long hours—at a pretty good pace. But, I couldn't pull any rough stuff like that! In all languages I was patted on the shoulder with a "Hey, buddy, where's da fire? What da hell, you kill you'-self! Twelve hours long time."

With each admonition I would "step my voltage" down a bit, until finally I moved those bricks just the way everybody else did,—so you could hardly tell whether I was moving at all.

On the twelfth hour everybody slept,—bosses and everybody else. Of course, the beginning of the *thirteenth* hour was, for many people, only a matter simply of the whiskey and beer.

People who have the idea that the great appeal for a drink is sociability should go into the steel towns as they used to be and see the men at the end of the twelfth hour—especially if it has been the twelve-hour night crowd—line up three deep to the bar, each man simply waiting his turn to get into the second line and then into the first, taking his glass of whiskey and on top of that the glass of beer, without saying anything to anybody,—simply for the purpose of making sure that they should get a better day's sleep through all the day-time noises of the children, the street-cars and so on. Everybody gave me the assurance that if you took a couple of "whiskey-beers" the thing was very easily done. So the drinking was simply a matter of adaptation to the situation and, of course, an adaptation which was all the time lowering the morale of the whole crowd.

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[1] Recently Vice-President Hydraulic Pressed Steel Company.

So I came to feel that largely because of the long turns, steel had got onto a sort of "mishap-basis." It is apparently figured all the time that there are going to be mishaps in steel,—that you are going to have spills, this mess or that. I am quite sure that with the heightening of the morale that can be expected from the short turns there is going to be a very definite saving from the lessening of spills and other accidents as the direct results of the increased quality of the men.

In connection with the foremen, this saving should be even greater. I am quite sure that management is paying a still higher price in terms of the lowered morale of the foremen. Most of the foremen that I saw did their job of sleeping regularly every night. At one plant the head of the labor department said with great pride that at least they had worked it out in that plant that the foremen did not sleep. I had to exercise great self-control in order not to let him see what a tremendous surprise he was handing me, inasmuch as every night at a certain time the word would go around, "Boss asleep; I work one hour, you go sleep." I still am unhappy to think of the night when I went into the gang at a new steel plant where the boss was thoughtless enough to go off without telling me where I could find him. So when I tried to join the crowd after the mid-night supper hour I had to lose an hour of my good time before I could find him and join the crowd fast asleep, so well hidden had he been. Of course, that never happened again!

All this meant, of course, that everybody in the gang felt that he "had something" on his boss when the boss was sleeping. Thus even these drivers, men that absolutely depended on their steam to drive the crew, couldn't even make their steam work because when the boss said to them "You get the hell out of here," they would answer "Go chase yourself, I tell your boss how much you sleep around here," and Mr. Gang Boss would let the subject drop.

Of course, men of that sort simply cannot be expected to really use good leadership in either getting the energies that the men have to give or in directing them toward the doing of the job. In many places I saw men doing things that seemed to me perfectly foolish, under the direction of the boss, simply because, in my opinion, you cannot possibly get a man who uses his head effectively to be a boss if he is required to drive men who are on the twelve-hour schedule. And I am quite sure that there can be a very real saving if, with the change to the three shifts, there may also be a change in the quality of the leadership given the men. You must have *drivers* with twelve-hour men. If you must have men who will be drivers, then you cannot possibly expect them to be good users of their heads, or good directors of the energies they get. So the moment you put in a three-shift system you ought to make sure you change the quality of your leaders.

Of course, in the labor gang it is not always necessary to change from the two-shift to the three-shift. That is because you don't have to be in absolutely continuous operation in the labor gang. You may have the device of the "staggered schedule"—with floating crews of laborers working two shifts of ten hours each, if you like, and then work down gradually to the eight-hour schedule with the help of experience.

Just one thing more. I am quite sure that there are big possibilities of saving on the new three-shift basis by means of careful "engineering revision." It seems to me too bad that in the "cinder-pit," where power is used on a more lavish scale than almost anywhere you can imagine, that there, right alongside of these tremendous cranes and instruments of power, men should be using more sweat than almost anywhere else. There night after night I would try to shovel that "cinder" out of the slag-pockets underneath the open-hearth furnace. Night after night I would shovel this very heavy material three or four feet, then move over three or four feet and shovel it another three or four feet, and finally get it into the box. With aching wrists and with tired back I would then stand and see the crane come along and take up the box as if with one of its little fingers and whisk it away, and I fairly wanted to scream at the d—d thing, that all that muscle should have to be given to it when it could be made perfectly needless if that box were swung in under by ten feet. (All of you will realize how profanity rises to the lips if you get such a feeling toward a crane and toward the use of power and toward the lack of engineering revision, when that feeling is in every muscle of your weary body.)

I am quite sure that engineering revision could have it so that the slag pocket, for instance, could be emptied by the destruction of a wall. Also things could be so placed in the steel plant that there could be a very great deal less of the use of the wheelbarrow and that sort of thing. In such ways I am sure it could be worked out to make much more effective the energies that men do give in the steel plant. In some cases I felt it was necessary to write an anonymous letter to the management that they had built up the whole system in days of cheap labor and that somebody ought to apprise them of the fact that labor was no longer cheap; everywhere it seemed to be the thing to take things very easily with regard to the saving of men's labor.

I am quite sure, finally, that now is the appointed time to make the change. It will be mentioned at a great many meetings of the workers that here are thousands of men out of work while in steel there are thousands of men on the twelve-hour turn.

Where there is so much of the human "thought" behind anything, I am sure that the problem *can* be worked out on a basis that is ethical, practical and right from every point of view.

Some one has said: "We breathe cheaply in the common air thoughts great hearts once broke for." Anybody who has had any experience with the eight-hour shift will agree that it would be a shame if any hearts were required to be broken for the bringing about of a change so manifestly to be desired from every point of view.

6. Telegrams and Letters

The following telegrams and extracts from letters represent the views of persons who had been invited to discuss Mr. Drury's paper but were unable to be present:

Have read Mr. Drury's paper with regard to Commonwealth Steel Company's experience with three-shift arrangement and glad to say his statements are correct. We feel the three-shift condition has enabled us to get a higher type of workman and has increased efficiency which has reflected itself in a higher quality of product and increased tonnage. It has reduced turnover. We find men more alert on an eight-hour turn. It has also minimized our accidents from both human and production standpoint as well as resulted in a more economical use of materials and prolongation of life of furnaces. We feel our experience has been most satisfactory on the three-shift arrangement.

CHARLES M. COOKE.[1]

Have read Drury's reprint. His investigation seems exhaustive; his attitude practical; his deductions unanswerable. I am more strongly convinced now than ten years ago of economic wisdom of abolishing twelve-hour shift in steel industry. Probably its leaders will never have better time than now to take action. Postponement must stimulate unrest and make practical basis of wage readjustment more difficult.

R. A. BULL.[2]

Mr. Drury was here about two weeks ago and had a long talk with the writer with respect to the three-shift system in the steel industry. It is our opinion that great caution and care must be exercised in arriving at any conclusions whatsoever with respect to the economic success where plans have changed from the two-shift to the three-shift plan. We are entering a period which is going to test many wage methods and plans of employees' representation which were inaugurated during a period of unbounded prosperity and labor shortage. Only yesterday I read a letter from an executive who was just leaving the employ of a large steel company because of certain changes in their policies which made his position no longer necessary. This Company has already made very sweeping changes in its personnel program by discontinuing its employees' representation scheme, etc., etc. We have heard of a few isolated cases where plants have already reduced hourly wages and changed back from the three-shift to the two-shift plan in order that the total weekly earnings of those employees who remained would not be reduced.

We have stated to Mr. Drury and others that we are opposed to the change from two shifts to three shifts by simply passing on an added cost to the public.

We have introduced the three-shift plan into all of our producing departments and most of our service departments, but it will take us some months before we can determine whether or not our unit cost has been maintained at the former level or increased or decreased.

CHARLES R. HOOK.[3]

VIII. APPENDIX

Report of a Committee of the Stockholders of the United States Steel Corporation— April 15, 1912

At the annual meeting of the stockholders of the United States Steel Corporation held April 17, 1911, the following resolution was adopted:

RESOLVED, That the chairman shall forthwith appoint a committee of not more than five persons from the officers, or stockholders, of this Corporation to investigate and report to the Finance Committee, as soon as may be but not later than October 1, 1911, as to the truth of the statements contained in a certain article appearing in the March number of the AMERICAN MAGAZINE under the title "Old Age at Forty," and that such a report together with such comment as said Finance Committee may desire to add thereto, shall thereupon be printed and mailed to the stockholders of this Corporation.

Pursuant to such resolutions, Hon. E. H. Gary, Chairman of the Board of Directors, appointed the following committee:

Thomas DeWitt Cuyler, of Philadelphia,
Stuyvesant Fish, of New York,
Darius Miller, of Chicago.
Charles A. Painter, of Pittsburgh,
Charles L. Taylor, of Pittsburgh.

The absence of several members of the committee, immediately following its appointment, prevented a full meeting until October 31, 1911, on which date the committee met for organization, electing Mr. Fish as chairman. Between that date and January 12, 1912, several meetings were held, at one of which Charles M. Cabot, the author of the resolution, and John A. Fitch, the writer of the article "Old Age at Forty," were present. They, with three members of the committee, held an all-day conference.

At the meeting held on January 12, 1912, William H. Matthew was chosen to act as secretary of the committee. Since that date, he has devoted his entire time to visiting many plants of the corporation, has interviewed workmen, superintendents, and officials, business and professional men in the mill towns, and has been in conference constantly with one or more members of the committee.

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[1] Supt. Open Hearth Dept., Commonwealth Steel Company, Granite City, Ill.

[2] Consulting Engineer (in foundry practice); Vice-President Du Quesne Steel Foundry Company; Sewickley, Pa.

[3] Vice-President and Asst. Gen'l Manager, The American Rolling Mill Company.

From the data gathered by our secretary, together with that obtained by the members of the committee, who, accompanied by Mr. Cabot on the committee's invitation, visited many of the works in the Chicago, Cleveland and Pittsburgh districts—giving to such inspection all their time from April 3 to April 12—the facts and recommendations which follow are submitted.

As a result of the several meetings held by the committee, for the study of the article under discussion, as also through conference with Messrs. Cabot and Fitch, it seemed that the main questions calling for consideration were.

(a) The seven-day week, and long turn,
(b) The twelve-hour day,
(c) The speeding of the workmen,
(d) The repression of the men.

Before taking up these questions singly, we believe we state the facts in saying that no one of these practices was inaugurated by the United States Steel Corporation. Rather were they in vogue, to a greater or less degree, in the various companies which were brought into one when the Steel Corporation was organized.

(a) *The seven-day week and long turn.* Until recent years, the seven-day week has been the general rule and practice followed in all the operations which are necessarily continuous, particularly in that of blast furnace work. Nor was it always confined to departments where such continuous operation was a metallurgical necessity. Recognizing the harmful effects of such schedule of work, the Finance Committee of the Corporation, on April 23, 1907, adopted and transmitted to the presidents of all subsidiary plants of the Corporation, the following resolution:

On motion, it was voted to recommend to all subsidiary companies that Sunday labor be reduced to the minimum; that all work (excepting such repair work as cannot be done while operating) be suspended on Sunday at all steel works, rolling mills, shops, quarries, and docks; that there shall be no construction work, loading or unloading of materials.

It is understood that it is not at present practicable to apply the recommendation to all departments, notably the blast furnaces, but it is desirable that the spirit of the recommendation be observed to the fullest extent within reason.

While the efforts made by individual officials to carry out the recommendation of the Finance Committee resulted in some progress being made toward compliance with same, in many plants it was disregarded in whole or in part. The explanation of this failure to detach from the steel industry the seven-day schedule of work may be best found, we believe, in that zeal of operating officials, for output, exclusive of all other considerations. This being contrary to the policy of the board, and at variance with the resolution of its Finance Committee, a telegraphic order of a pre-emptory character was issued by Judge Gary, on March 18, 1910, to the presidents of all constituent companies, reading as follows:

> Mr. Corey, Mr. Dickson and I have lately given much serious thought to the subject-matter of resolution passed by the Finance Committee April 23, 1907, concerning Sunday or seventh-day labor. Mr. Corey has written you concerning the subject within a day or two. The object of this telegram is to say that all of us expect and insist that hereafter the spirit of the resolution will be observed and carried into effect. There should and must be no unnecessary deviation without first taking up the question with our Finance Committee and asking for a change of the views of the committee which probably will not under any circumstances be secured. I emphasize the fact that there should be at least 24 continuous hours interval during each week in the production of ingots.
>
> (Signed) E. H. GARY.

Whether viewed from a physical, social or moral point of view we believe the seven-day week is detrimental to those engaged in it. While not wishing to imply that the method adopted by any individual official or any combination of two or more methods would be the best to meet requirements in all mills, we are strongly of the opinion that no matter what alleged difficulties of operation may seem to hinder the abandonment of the seven-day week, they must be met.

The records of today indicate that with the exception of two or three plants, the seven-day week has been relegated to the past.

The resolution of the Finance Committee, as subsequently emphasized by Judge Gary, was strictly mandatory in character and should, in our judgment, be absolutely enforced at all times, in all mines, mills, shops, railways, docks, and works of the Steel Corporation. Any tendency on the part of anyone to disregard the spirit of the letter of such order should be sufficient cause for removal from service.

Closely allied with the question of the seven-day week, is that of the excessive hours of labor involved in continuous processes, caused by the changing of the working shifts from day turn to night turn and vice versa. An examination of the time sheets of many of the mills shows that this practice has been entirely abolished in many of the departments and not in others. We recognize that at rare intervals there may come emergencies and unusual conditions that would make absolute enforcement of any exact schedule of work hours impracticable, a fact equally true in any field of industry and commerce. Our investigation, however, leads us to believe that it is feasible and practicable to eliminate the long turn formerly followed in the changing of shifts in continuous process work, and that it should be done. Further, that conscientious efforts should be made by all to reduce to a positive minimum any undue length in work hours that emergencies and unforseen conditions may sometimes demand.

(b) *The twelve hour day.* To ascertain the number of employees of the Steel Corporation working on a twelve-hour schedule (exclusive of officers, managers, and clerical forces), we have examined the records of 175,715 men. Of this number we find 45,248 or 25¾% are at present working twelve hours per day. Generally speaking, this schedule of work finds its largest proportion in those departments which are more or less continuous, such as rolling mills, open hearths, and blast furnaces, where the percentage working twelve hours varies from 50% to 60%. The explanation of such fact may be found partly at least, in the introduction of a large number of mechanical improvements which have steadily cut down the exhausting drudgery and the severe physical labor that was characteristic of many of the processes in the earlier years of the iron and steel industry. The actual physical labor involved in many of the positions is, today, much less than in former years, this being especially true of the open hearth and blast furnaces, where the intermittent character of the work is such that there is less call for actual expenditures of physical energy than in many of the 8 and 10-hour positions.

Notwithstanding this fact, we are of the opinion that a twelve-hour day of labor, followed continuously by any group of men for any considerable number of years, means a decreasing of efficiency and lessening of the vigor and virility of such men. The question should be considered from a social as well as a physical point of view. When it is remembered that the 12 hours a day to the man in the mills means approximately 13 hours away from his home and family—not for one day, but for all working days—it leaves but scant time for self-improvement, for companionship with his family, for recreation and leisure. It is important that any industry be considered in its relation to the home life of those engaged in it, as to whether it tends to weaken or strengthen the normalness and stability of family life. By a reasonable conserving of the strength of the working population of today may we be best assured of a healthy, intelligent productive citizenship in the future.

We are not unmindful of the fact that the 12-hour day has by its general acceptance and practice over a considerable period of years become firmly entrenched, and that any sudden or arbitrary change would involve a revolution in mill operations. Nor are we at all sure that it would be possible for any one employer, or any number of employers, to inaugurate a shorter hour system, unless a similar policy should be adopted by all employers engaged in the same industry. We do believe that following in the wake of other betterment of conditions in the steel industry, there will naturally come a shortening of the hours of labor and the eventual abolishment of the 12-hour day, which will tend toward increasing the efficiency and resourcefulness of the working population and for that reason, bring benefit to both employer and employed. That steps should be taken now that shall have for their purpose and end a reasonable and just arrangement to all concerned, of the problems involved in this question—that of reducing the long hours of labor—we would respectfully recommend to the intelligent and thoughtful consideration of the proper officers of the corporation.

(c) *The speeding of the workmen.* In the article which is under discussion, considerable criticism is made against the system of payment of wages by piece work. We do not believe that there has been evolved any fairer or more generally accepted method of payment for labor. Likewise, what is known as the "bonus" system which has been largely employed by the Steel Corporation as an incentive to increase in output and efficiency, is objected to as tending to result in a system of speeding, harmful to the men.

That there is possibility of abuse in these systems is true. Have there ever been devised rules of procedure in any field of industry free from such possibility? Our observation of labor conditions in the mills of the Steel Corporation does not lead us to believe that there is either desire or tendency on the part of foremen and superintendents to pursue these policies to a point that would mean harm or injury to the men under their charge. It is, of course, within the province of the

Board of Directors, and they should employ the necessary means whereby they would always be conversant with and able to promptly check any official, who in his anxiety for output, becomes disregardful of the possible injury to his men by overspeeding and excessive strain.

As general operating policies, we believe the "bonus" system and the payment of wages by piece work to be of advantage both to employer and employe, guarding as they do against that dead level of wages regardless of the ambition, the resourcefulness, the efficiency of the individual concerned. They are the exemplification of the *esprit de corps* that is essential to the success of all enterprises; they are but a part of that spirit of contest and competition that is characteristic of all American life, whether it finds expression in the schoolroom, on the athletic field, in the target contests of army and navy, or in the legitimate striving for "place" among workmen, foremen, superintendents, managers and higher officials in any field of commerce and industry. Thru their operation, the qualities of perseverance, ingenuity and grit have opportunity for expression, development and reward. As stated above, these special bonuses are offered as an incentive for increase in output and efficiency. That they should find fair and just distribution among all those whose efforts and labor contribute to any resultant increase in production, or economics, would seem to be a subject calling for consideration and action.

(d) *The repression of the men.* The Steel Corporation has made efficiency the one standard by which continuance of employment in its plant is determined. If we are to understand the term "repression of workmen" as a criticism of, and objection to, this defined policy, then the implied charge is true. If on the other hand, it involved the question as to what measures the officers of the Corporation should adopt for the suppression of organizations that in the past have, at times, proved irresponsible and incapable of self-control, that have advocated and ofttimes insisted upon what are believed by many to be fallacious theories and practices, then, at least, the charge may well be open to discussion.

As a committee of stockholders, we do not believe the final solution of the problems involved in this question has been reached. We do believe the present methods are preferable to the old for all concerned, and that the Steel Corporation, in view of the practices often pursued by labor organizations in steel mills in past years, is justified in the position it has taken. That the method of employment today must prove to be the best for the future is a question on which there may well be a difference of opinion. The interests of society and the community at large will not best be served by that type of mind, whether it be employer or employe which bases action on the assumption that might makes right. On the contrary, the adjustment of the relations between employer and employe is a task for men of sound minds, reciprocal natures, broad sympathies and courage, men who believe that the future may be made better than the present. May it not be reasonably hoped that such men, whether they be officials or wage-earners, may more and more be found working together to bring forward the day when employer and employe shall enter into a common administration of industrial interests. In the article under discussion "Old Age at Forty," mention is made of the general social welfare policies inaugurated at different times by the Steel Corporation. It would seem to be in the province of this report to briefly outline those policies, and to consider their value as affecting the relationship of employer and employe.

Safety Department

It is not necessary here to trace the growth of the earlier efforts made by different subsidiary companies toward the prevention of accidents, to the time when they found their culmination in the organization of a central committee of safety early in the year 1908, which committee was given the power to examine all the various plants of the corporation, and as rapidly as possible to bring every mill to the highest possible point of effectiveness in accident prevention. That committee has and is carrying on a determined and effective campaign for safety all along the line. Its work is considered as important a subject as any that the Corporation has to contend with in the manufacture of its products. From the start it has worked on a sound, vigorous and scientific system of accident prevention. The central office of the Safety Department is in New York, in charge of an acknowledged expert, with several assistants, and supplemented by local safety committees in each of the subsidiary companies, which, in turn, are supplemented by subcommittees of foremen and workmen, all striving to study and safeguard the lives and welfare of employes. During the years 1910 and 1911, there was expended $1,750,000 for safety, and large appropriations have already been granted for a continuance of the work. Gratifying results have been accomplished as evidenced by the fact that the percentage of serious and fatal accidents throughout all the plants of the Corporation shows a decrease of 43% since 1906. This reduction of serious and fatal accidents, based on the normal number of employes (200,000) means 2,300 less in 1911 than in 1906. Prevention is but the first step in the system of accident and relief work as carried on by the Corporation. Nearly every plant has its emergency hospital equipped to render first aid to any workmen injured. Each mill has its surgeon and nurse to administer promptly the necessary assistance in case of accident, and the company provides efficient hospital treatment, either in its own hospitals or those of the community.

Voluntary Accident Relief Plan

In spite of all precautions taken and all efforts towards prevention, there will occur many accidents in any large industry involving temporary or permanent disability, and sometimes death. To Andrew Carnegie, the steel industry is indebted for the first voluntary relief measures. In 1901, he created a trust of $4,000,000, the income of which was devoted, within the Carnegie interests to the relief of families from whom the breadwinner had been removed by accidental death, to the temporary relief of those employes meeting with work's accidents, and to the pensioning of superannuated employes, and those permanently disabled. From this fund, there was disbursed in nine years, the sum of $1,756,955.59 among 9,746 employes. What has been the policy of the corporation in this matter of ameliorating the conditions which accidents often bring to the homes of its employes? In May, 1910, it established a plan of relief whereby it made voluntary provision for the care and benefit of all employes injured and for the families of those killed. In a report of this nature, we cannot discuss the considerable detail of such a system. During the years 1910, 1911, $3,133,000 was paid in aid of workmen who were injured in the mills, and to the families of those men who were killed in service. In addition to this voluntary relief on the part of the corporation, there exists in some of the subsidiary companies plants employes' beneficial associations for insurance against sickness and death from causes other than mill accidents. To the funds of these both the men and the company contribute, and in their administration there is a similar partnership. That there should be an extension of this form of insurance would seem to us desirable.

Pensions

In addition to voluntary accident relief, the U. S. Steel Corporation appropriated in January, 1911, a fund of $8,000,000 for pension purposes, which was combined with the fund of $4,000,000 which had been established in 1901 by Andrew Carnegie for the benefit of the employes of the Carnegie plants. The income from the aggregate amount is now being used for the benefit of all employes of all the subsidiary companies of the corporation. The pension obligations of those subsidiary companies, which had put into operation pension provisions prior to 1911, were assumed by and merged into the new fund. The record of operations of this fund for the year 1911 was as follows:

Total number of pensioners Dec. 31, 1911	1,606—
Number of pensions granted during 1911	565—
Total disbursements during 1911	$348,480.37—
Average pensions granted per month	$20.75—
Average age of employes pensioned	66 2/3 yrs.
Average length of service of pensioners	30 4/10 yrs.

Sanitation and Welfare

We have found that much attention has been given to the matter of sanitation in many of the mills. Pure drinking-water systems, sanitary lavatories, locker rooms, shower baths, and other like provisions are being established in many of the plants. Not all have traveled as far nor as diligently along this line of improvement as we think they might. Along the line of general welfare work, scattering efforts are being made in the way of providing places of recreation, such as club rooms, playgrounds and other agencies for the families of employes. District nurses have been employed by some of the companies; sanitary engineers by others. Specialists have been employed to investigate and report on all questions affecting social welfare. An educational movement along these lines is now being inaugurated, and when that same energy and uniformity of practice that is characteristic of the safety department shall have been brought to bear upon the question of welfare, either directly or in cooperation with agencies already at work in the towns, much of permanent value can, and, we believe, will be accomplished. With the question of shorter hours of labor, is closely allied this one of providing means and places by and in which the leisure hours gained may be profitably spent. It is not a question for the Steel Corporation alone. Rather is it one to which society as a whole may well address itself. During the year 1911, the corporation expended $1,250,000 for this general betterment work.

Stock Distribution

In the year 1903, a plan was inaugurated, under which shares of preferred stock were offered to all employes and which practice has continued yearly since. A premium of $5 per annum for five years is paid on each share of preferred stock purchased by employes under this plan. As of December 31, 1911, 24,588 employes were stockholders under this plan; their aggregate holdings amounting to 102,245 shares of stock. In response to the 1912 circular concerning employes stock distribution, the following table shows the subscriptions therefore:

	Number of Employes Subscribing	Number of Shares of Stock
Employes receiving less than $800 a yr.	15,349	17,233
Employes receiving $800 to $2,500 a yr.	20,096	35,255
Employes receiving over $2,500 a yr.	1,501	8,866
TOTAL	36,946	61,354

While in the mills, we have made special point to ascertain from the workmen themselves their attitude toward this plan, and we have found most of them well informed as to its provisions. Many with whom we have talked were holders of one or more shares of stock. Our belief that the plan has encouraged thrift and stimulated the men to save was but strengthened by the remark volunteered by several of the men with whom we talked—that they "had never saved any money until they began this way." An impartial examination of all the facts presented in this report will show that much work has already been done by the U. S. Steel Corporation for the betterment of conditions under which their employes work and live.

We believe that there is evidenced a widening sense of social responsibility; an increased willingness to accept the heavier burdens and obligations which have come with the development of modern industry. Yet, not less evident is the fact that there is necessity for still larger accomplishment in the future. Elsewhere in our report we have suggested some of the lines along which that should be wrought. It may not be amiss to say that the resolution passed by our fellow stockholders imposed a task upon this committee requiring much labor, careful investigation, and conscientious consideration. To approach the questions raised by the article under discussion with fair and open minds; to ascertain and present the real facts; to search for the practical, rather than the theoretical; to reach conclusions that should not be affected in any way by opinions gleaned from this or that possibly prejudiced source, whether of employer or employe—in that spirit have we endeavored to do the work entrusted to us. To that high tribunal, that final court of appeal—public opinion—we submit our conclusions and recommendations. The dissatisfaction and unrest which plainly exist in the industrial world today will not be lessened or removed by a policy that limits itself to a fault-finding destructive line of action, but rather by one that will in tangible definite fashion recognize and follow that constructive and conserving leadership of which we believe there is evidence, both in the ranks of employers and employes. There may be those, perhaps, who will accuse us of unwarranted optimism in expressing the hope that the men who, in the manufacture of iron and steel have been so successful in that invention and application of wonderful mechanical appliances, who have won success in the administration of immense enterprises—that these same men will lead and achieve in the just solving of the social and human problems that in this same industry press for answer. The publicity accorded by the Steel Corporation quarterly in its financial statements, and monthly in its tonnage statements, has placed it in this respect far in advance of other corporations, and by doing so, has gained for it the confidence and trust of the public.

In conclusion, we respectfully recommend to the Board of Directors of the Steel Corporation that hereafter, and at stated periods, a statement shall be submitted to the stockholders dealing with the questions discussed in this report, so that correct and reliable information first hand, may be available as to the advancement and betterments being effected in these equally vital and important fields of endeavor.

Respectfully submitted,

Stuyvesant Fish,
Thomas DeWitt Cuyler,
Darius Miller,
Charles A. Painter,
Charles L. Taylor,
Committee of Stockholders.

New York, N. Y., April 15, 1912.

SCIENTIFIC MANAGEMENT AND THE REDUCTION OF UNEMPLOYMENT[1]

By H. S. Person[2]

In scientific management are contained two fundamental ideas. The first is that management should analyze every phase or element of the business so far as possible in accordance with the scientific method—the method which by research, investigation, experiment or otherwise secures all available data concerning each phase or element of the business—physical, physiological or psychological—and derives therefrom relatively stable and dependable facts on which to base plans and procedure. You who are not acquainted with conventional factory and office operations will be surprised how revolutionary an idea that is; to what extent business is permeated by the habit of tradition, imitation, speculation and taking things as they are or as they come.

The second fundamental idea is that, these dependable facts once ascertained, plans for operation and operating controls shall be developed which are relatively precise in their intentions and expectations of results, because based upon a knowledge of conditions resulting from the preceding scientific analyses. This makes possible such a coordinating of the energies embodied in brains, muscles, equipment and materials, as to secure the maximum product with the minimum effort, and with minimum waste of any one of these forms of energy; and it makes possible also a better coordination of production with analyzed demand and on that account a diminution of that social waste which results from mistaken production.

In support of the first fundamental idea have been developed such mechanisms, among others, as job analysis, time study, fatigue study and statistical analyses of all sorts; in support of the second fundamental idea such mechanisms, among others, as routing, order of work, instruction cards, inspection, functional foremanship, precise specifications for materials, and progress records. However, it is the fundamental ideas rather than the mechanisms which all of us should and so few of us do keep in mind.

To what extent is this scientific procuring and analysis of data and the development of precise operating plans and controls possible in the conduct of an enterprise? This question leads to a distinction between administration and management and to a further definition of management.

If you will have in mind the conventional organization of a business you will recall that it presents logically three fields of activity; a field represented by the stockholders, directors, and president, in which is determined the purpose and the larger, far-reaching, governing policies of the enterprise; another field presented by the manager, superintendent, assistant superintendent and their assistants in which is determined the immediate operating policies and methods, and in which resides the immediate control of operations; and a third field in which is found the foremen and workers—those who actually conduct the necessary operations. The general manager may be considered the individual who ties the first two fields together, and the foremen as the individuals who tie the second and third fields together. Field one let us designate by the term administration and field two by the term management.

Now it is probably perfectly obvious to you that, while statistical and similar methods of investigation and research may be utilized in solving the problems pertaining to the administrative field, it would nevertheless be incorrect to say that industry has developed any such thing as scientific administration. Each year more decisions are being made on the basis of facts determined by a greater utilization of the scientific method, but nevertheless a large proportion of the decisions in this field are made as the result of intuition or sound judgment or a wisdom which grows out of long experience.

On the other hand, in the field designated by this narrower application of the word management, it is possible to utilize to a high degree the scientific method of determining facts, and to establish plans of operation and controls for operation which have an astonishing precision in forecasting and securing results, and in securing these results with a minimum waste of time and of the elements which enter into production, and with a minimum of that waste which results from the absence of coordination between production and consumers' demand. It is really in this narrower sense of the word management that the term scientific management should be used.

We have now come to an understanding of the meaning of scientific management and of the distinction between administration and management, which will make profitable an attempt to answer the question implied in the title of my talk: What may scientific management have to do with the reduction of unemployment?

I think I shall be expressing correctly the judgment of the more thoughtful management engineers when I make a general answer to the question as follows: While scientific management alone cannot solve the problem of unemployment, it can exert a profound influence in that direction, and particularly, it is a condition precedent to any substantial diminution of unemployment.

Scientific management alone cannot solve the problem, for the reason that unemployment is so largely a problem of administration. If you consider the nature of our social organization for industrial purposes, the motives which inspire industrial enterprise and the mental habits which enterprisers have developed in the industrial regime which characterizes our civilization, you will perceive that there is inevitable a certain amount of unemployment and the danger of a very considerable amount. We are organized to conduct industrial enterprises as a more or less speculative undertaking; possessors of administrative and managerial ability speculate in combining with that ability hired capital and labor, or possessors of capital speculate in combining with their capital hired administrative and managerial ability and labor. And just as they buy material things when they think they need them, and refrain from buying when they see no profit in the turnover, they also hire or discharge workers according to their judgments of the state of the market. We must not forget that while production is the creation of utilities for the satisfaction of human wants, and sounds like a very simple undertaking, it is in practice by no means simple. The total of human wants is uncertain and must be estimated; the part any individual enterprise may take in their satisfaction is more uncertain and must be estimated; and the kinds and quantities of the elements which must be combined by an enterprise for creating the utilities which will satisfy the wants is uncertain. It is more or less of a speculation and both materials and human energy suffer the risk of being or not being marketable to those who do the speculating. The dominating motive in industry is the making of profits, and the attitude of mind towards employment and unemployment is determined chiefly by that motive.

It is a fact that for various reasons—modification of the profits motive by the service motive, an increasing spirit of humanitarianism, and perhaps particularly the pressure of the workers in collective action—the problem of unemployment is being considered more and more seriously by administration. But I think we have lost our perspective if we fail to realize that the profits motive is still dominant, and enterprise—manufacturing as well as merchandising—is chiefly a speculating activity.

Perhaps if administrators had more time to give to administrative problems—the problems of the long look ahead and the wide look around, problems pertaining to the economic and the trade environment of the business itself—there might be more concerted action looking towards the reduction of unemployment. But most administrators feel that they do not have the time. They are too much absorbed in immediate problems of the plant and late afternoon worries. That suggests one of the reasons why management engineers believe that scientific management is a condition precedent to any thoroughgoing attack on the unemployment problem in the plane of administration.

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[1] An address delivered before the American Association of Public Employment Offices, Ottawa, Sept. 20, 1920.

[2] Managing Director, The Taylor Society.

For if our enterprises were better organized and better managed, so that the managerial and operating departments were functioning more or less automatically in accordance with well-established administrative purposes and principles, administrative executives would then be able to do their work in accordance with the exception principle—a principle which leaves to the managerial force the responsibility for working plans and details, and to the administration force the responsibility for the exceptional detail and the governing policies.

On the basis of such organization and management only is the administrative executive free to give proper attention to long-run policies and major problems—to such problems as unemployment in its administrative aspects. Such a basis of organization and management is assured only where there is superior management. *It is scientific management in the plant which gives freedom in the administrative field.*

You know this to be so from your own experience. As public employment officers you have had occasion to attempt to persuade executives of plants to adopt large policies which would promote your work of amelioration of unemployment, and you have found them too busy, too intent on details of management, to listen to your arguments sufficiently to be persuaded; or if persuaded, too much held down by details to take action in accordance with the persuasion. Too few of them have the freedom *for* cooperation in your larger plans, because they have not the freedom *from* details of management, which exists only where there is scientific management.

This indirect help of scientific management in freeing administrators to attack the problem of unemployment is not the only help it offers. Scientific management itself contributes directly to the reduction of unemployment.

No matter what policies those ultimately responsible for the conduct of enterprises may adopt, no matter what assistance the state may render through such service as you represent, *the effective effort to reduce unemployment will be made in the individual shop or office,* where policies are given concrete expression. Directors may declare that their ideal is continuity of employment, but the extent to which the ideal is realized depends upon the effectiveness with which managerial executives, the planning room and the operating staff do their work.

Most enterprises operate under competitive conditions in markets in which the demand fluctuates. Business has not learned how to free itself from those alternating conditions known as buyers' and sellers' markets; nor have many enterprises learned how to free themselves from the seasonal demands which characterize the disposition of their output. Under such circumstances the taking on of workers in one year and the discharge of workers in another year, or the taking on of workers in one season and their discharge in another, is to some degree inevitable; and only the most scientific of managements is able to reduce these variations in employment to a minimum. The competitive enterprise which succeeds in reducing these variations to a minimum is the enterprise which works out a balanced production of the various products according to seasonal demand; which establishes a schedule which coordinates the financing, producing and selling of these products; which has such organization and methods of planning and operating control in its several departments as to maintain the schedule of coordinated financing, production and selling; which as a result of exhaustive investigation and analysis has such command of the elements entering into its operations as to make possible the coordinations, schedules and controls I am enumerating; and, not least, which has such a policy of human relations and such a special handling of the personnel problem as to reduce to a minimum the variations in that particular element known as labor.

In the degree to which an enterprise has such management may it hope to achieve continuity of employment. That kind of management is scientific management.

There is another aspect of unemployment to which adequate attention is not given. That is unemployment within employment. We usually consider the unemployment problem as concerned with the workers who are without jobs—not on payrolls. There is the equally serious problem,—perhaps more serious because more insidious, for it exists frequently when we believe we have no problem of unemployment,—that of the workers who are on payroll, but are laid off part of the time; or who, if not formally laid off, do not have wage-producing work coming through to them. There is more of that than most people suspect, and it is deadly in its effects. The only approach to a solution of that problem is through the management which knows just how many workers it can provide with work, and has such control of its processes as to insure a steady flow of work—scientific management.

We hear a great deal these days about unemployment insurance—the setting aside of part of the profit of good years to insure an income to workers during bad years. Some such institution is bound to come, for it is based upon the incontrovertible theory that an industry must carry all who are in the long run essential to its existence—workers as well as owners of capital; upon the theory that a worker invests his life in an industry just as a capitalist invests his savings. Assuming that the problem of unemployment—for irregularity of income for the workers is an aspect of the problem—is to be attacked in that way, tell me, if you please, how any particular enterprise, or any particular industry, is to carry the burden of unemployment insurance, if it is inefficiently conducted? The advocate of unemployment insurance is consciously or unconsciously an advocate of scientific management.

I observe in your program for this meeting evidence that you are conscious that good technique in management is essential to *your* larger purposes. Your program of Wednesday forenoon in particular is concerned with the technique of your work. You want to make every employment office a perfect machine. You realize that you may agree upon splendid policies, but that you cannot make them effective without good technique in the conduct of your operations. Likewise with respect to industrial policies,—among them policies concerned with the solution of the problem of unemployment,—industrial society cannot achieve results without a basis of good operating technique.

If I were to leave with you one thought it would be this: attempt to work yourselves out of a job. You will never be able to do it, for there is bound to be more or less unemployment, and your service is a splendid effort to relieve unemployment. Just now, confronted with the disorganization resulting from war, your problem is a gigantic one. But look ahead to the more settled conditions of peace; and resolve from this moment on to conduct a campaign of education for better management in every plant with which you have contact, so that unemployment and the necessity of your service of amelioration may be reduced to a minimum.

REVIEWS

Personnel Administration: its principles and practice, by Ordway Tead and Henry C. Metcalf. (New York: McGraw-Hill Book Co. 1920. Pp. xii, 538.)

This book is a concrete, constructive contribution to personnel administration as a major function in management. There is a pleasing absence of forms and of insistence on definite detail. The authors' formal definition of personnel administration shows how large in their estimation the profession is: "Personnel administration is the direction and coordination of the human relations of any organization with a view to getting the maximum necessary production with a minimum of effort and friction, and with proper regard for